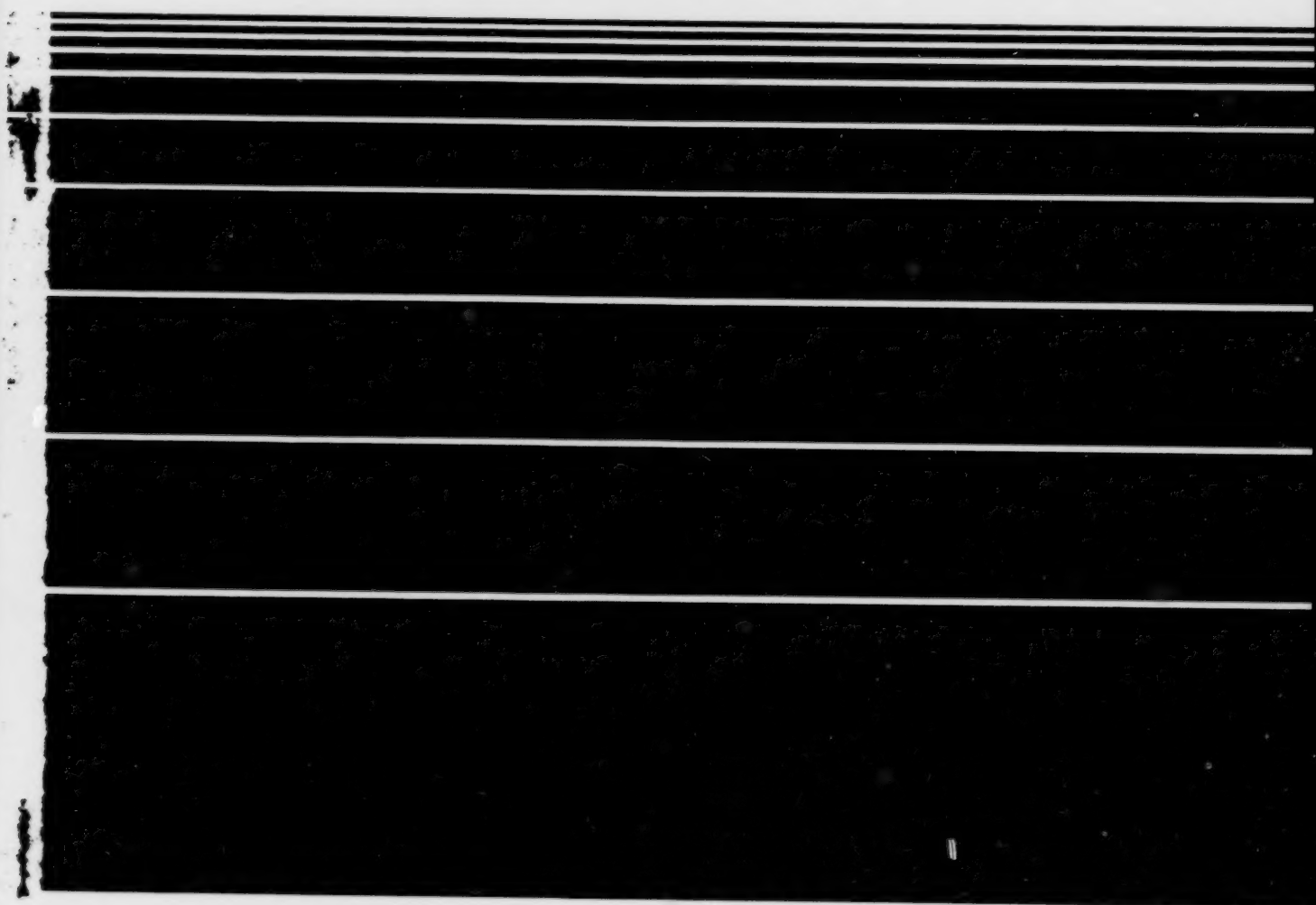

Manitoba
Environment
and Workplace
Safety and Health

MG-8159

MANITOBA AMBIENT AIR QUALITY
ANNUAL REPORT - 1984

by
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Air Standards and Studies Section
Environmental Management Services Branch

Air Standards and Studies
Report No. 85-10
November, 1985

Regehr, D. 1985. Manitoba Ambient Air Quality Annual Report - 1984, Department of Environment and Workplace Safety and Health, Air Standards and Studies Section, Report No. 85-10. pp. 53.

Abstract

As part of an on-going monitoring program, the Manitoba Government's Environmental Management Division monitored the quality of ambient air at a number of urban locations during 1984. This monitoring consisted of the use of established (or establishing) monitoring sites having dedicated instrumentation for continuous air sampling and analysis.

The ambient air quality program is structured to determine air quality in two receptor areas: general urban air quality and air quality in the vicinity of specific industries.

The general urban air quality program was conducted primarily in conjunction with the Federal/Provincial National Air Pollution Surveillance (NAPS) program. Sampling at NAPS sites consisted of measurement of the major air pollutants including ozone, carbon monoxide, sulphur dioxide, total suspended particulates, soiling index and lead. Of these contaminants ozone and total suspended particulates most often exceeded the Provincial air quality objectives. Based on the Canadian Annual Index of Air Quality, Winnipeg's air quality was rated as "Fair".

The monitoring of air quality in the vicinity of specific industries having (or potentially having) atmospheric emissions was restricted primarily to the areas around the major Northern metallurgical smelters (Flin Flon and Thompson), the pulp and paper mill at The Pas and a fertilizer manufacturer in Brandon. Monitoring was specifically for the pollutant of industrial emissions. Data from the above locations showed that, on occasion, depending on meteorological conditions and to a lesser extent on plant upsets, levels above air quality objectives/guidelines were also measured.

TABLE OF CONTENTS

	PAGE
ABSTRACT	
TABLE OF CONTENTS	i
LIST OF TABLES AND FIGURES	ii
INTRODUCTION	1
BACKGROUND	3
A) MANITOBA AIR QUALITY OBJECTIVES AND GUIDELINES	3
B) POLLUTANTS	9
C) SAMPLING SITES	16
D) AIR QUALITY INDEX	25
RESULTS	28
DISCUSSION	37
BIBLIOGRAPHY	52
APPENDIX	53

LIST OF TABLES AND FIGURES

TABLES		PAGE
Table 1	Guidelines and Objectives for Various Air Pollutants	4
Table 2	Ambient Air Monitoring Sites	17
Tables 3 - 7	Annual Pollutant Summary Data Statistics	31
Table 8	Air Quality Indexes	36

FIGURES		
Figure 1	Manitoba Ambient Air Quality Monitoring Network	19
Figure 2	Winnipeg Ambient Air Quality Monitoring Network	20
Figure 3	Brandon Air Monitoring Stations	21
Figure 4	The Pas Ambient Air Quality Monitoring Station	22
Figure 5	Flin Flon Air Monitoring Stations	23
Figure 6	Thompson Ambient Air Quality Monitoring Station	24
Figure 7	Carbon Monoxide Levels Winnipeg, Scotia & Jefferson..	APPENDIX
	Carbon Monoxide Levels Winnipeg, 65 Ellen Street.....	
Figure 8	Carbon Monoxide Levels Winnipeg, 604 St. Mary's Rd...	
Figure 9	Nitrogen Dioxide Levels Brandon, Assiniboine Community College.....	
	Nitrogen Dioxide Levels Winnipeg, Scotia & Jefferson.	
Figure 10	Nitrogen Dioxide Levels Winnipeg, 65 Ellen Street....	
Figure 11	Ozone Levels Brandon, Assiniboine Community College..	
	Ozone Levels Winnipeg, Scotia and Jefferson.....	
Figure 12	Ozone Levels Winnipeg, 65 Ellen Street.....	
	Ozone Levels Winnipeg, 604 St. Mary's Rd.....	
Figure 13	Ammonia Levels Brandon, Assiniboine Community College	
Figure 14	Hydrogen Sulphide Levels The Pas, Provincial Bldg....	
Figure 15	Sulphur Dioxide Levels Flin Flon, Downtown.....	
	Sulphur Dioxide Levels Flin Flon, Channing Drive.....	
Figure 16	Sulphur Dioxide Levels Thompson, 59 Elizabeth Rd.....	
Figure 17	Soiling Index Levels Winnipeg, Scotia and Jefferson..	
	Soiling Index Levels Winnipeg, 65 Ellen Street.....	
Figure 18	Soiling Index Levels Winnipeg, 604 St. Mary's Rd.....	
Figure 19	Total Suspended Particulates Winnipeg, 1350 Pembina Hwy.....	
	Total Suspended Particulates Winnipeg, 2109 Portage Ave.....	
Figure 20	Total Suspended Particulates Winnipeg, 800 Marion St.	
	Total Suspended Particulates Winnipeg, 299 Scotia St.	
Figure 21	Total Suspended Particulates Winnipeg, 65 Ellen St...	
	Total Suspended particulates Winnipeg, 604 St. Mary's Rd.....	

LIST OF TABLES AND FIGURES CON'T

Figure 22 Total Suspended Particulates, St. Francois Xavier....
Total Suspended Particulates Brandon, Assiniboine Community College.....
Figure 23 Total Suspended Particulates Brandon, 1104 Princess Street.....
Figure 24 Lead Winnipeg, 1350 Pembina Hwy.....
Lead Winnipeg, 2109 Portage Avenue.....
Figure 25 Lead Winnipeg, 800 Marion Street.....
Lead Winnipeg, 299 Scotia Street.....
Figure 26 Lead Winnipeg, 65 Ellen Street.....
Lead Winnipeg, 604 St. Mary's Road.....
Figure 27 Lead, St. Francois Xavier.....
Lead Brandon, Assiniboine Community College.....
Figure 28 Lead Brandon, 1104 Princess Street.....
Figure 29 Sulphates Winnipeg, 2109 Portage Avenue.....
Sulphates Winnipeg, 800 Marion Street.....
Figure 30 Sulphates Winnipeg, 299 Scotia Street.....
Sulphates Winnipeg, 65 Ellen Street.....
Figure 31 Sulphates Winnipeg, 605 St. Mary's Road.....
Sulphates Brandon, Assiniboine Community College.....
Figure 32 Sulphates Brandon, 1104 Princess Street.....
Figure 33 Nitrates Winnipeg, 2109 Portage Avenue.....
Nitrates Winnipeg, 800 Marion Street.....
Figure 34 Nitrates Winnipeg, 299 Scotia Street.....
Nitrates Winnipeg, 65 Ellen Street.....
Figure 35 Nitrates Winnipeg, 604 St. Mary's Road.....
Nitrates Brandon, Assiniboine Community College.....
Figure 36 Nitrates Brandon, 1104 Princess Street.....
Figure 37 Winnipeg Air Basin Dustfall.....

INTRODUCTION

The Air Standards and Studies Section of the Environmental Management Division has been monitoring ambient air at several locations throughout Manitoba since 1968. Monitoring currently takes place in Winnipeg, Brandon, Thompson, Flin Flon and The Pas.

The majority of sampling is of a continuous nature involving dedicated monitors in permanent stations and can be divided into two basic categories; (1) General or Urban Air Quality monitoring and (2) Source specific or Industrial monitoring. Much of the General or Urban Air Quality monitoring is performed under the auspices of the Federal Government's National Air Pollution Surveillance (NAPS) program, which provides a nationwide data base for determining the extent of air pollution in Canada, and also documents trends arising as a result of changing industrial activity, fuel use, population density and use of pollution control strategies.

Source specific or Industrial monitoring is performed by the Impingement Program within the Air Standards and Studies Section. This monitoring contributes to the evaluation of ambient air quality in the vicinity of specific industries in order to determine compliance with Provincial air quality guidelines and objectives.

This report covers the 1984 data for the following parameters: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Nitric Oxide (NO), Ozone (O_3), Ammonia (NH_3), Hydrogen Sulphide (H_2S), Sulphur Dioxide (SO_2), Soiling Index (COH), Total Suspended

Particulate (TSP), Lead (Pb), Sulphates (SO_4), Nitrates (NO_3), Dustfall and Sulphation.

The objectives of this report are; (1) to outline ambient air monitoring activities in the Province during 1984, (2) to provide summary statistics and a comparison to air quality objectives and/or guidelines (where applicable), (3) to compare 1984 data with 1983 data and (4) to provide a rating of the air quality relative to the Canadian Annual Index of Air Quality.

BACKGROUND

A) Manitoba Air Quality Objectives and Guidelines

The Province of Manitoba has adopted the National Ambient Air Quality objectives for those pollutants for which such objectives have been promulgated (sulphur dioxide, suspended particulate matter, carbon monoxide, ozone and nitrogen dioxide). Air Quality Guidelines have been developed and adopted internally for the remaining pollutants.

The above criteria have been designed about two levels:

Maximum Acceptable Level (MAL) - these criteria pollutant levels are intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being.

Maximum Desirable Level (MDL) - these criteria pollutant levels define long term goals for air quality and provide a basis for an antidegradation policy for the unpolluted part of the country and for the continuing development of control technology.

In the majority of cases, urban air quality is expected to meet the MAL, whereas, in rural areas, it is the long term goal to ensure that the MDL's are not exceeded.

A list of "Ambient Air Criteria" currently endorsed by the Environmental Management Division is presented in Table 1.

TABLE 1

GUIDELINES AND OBJECTIVES FOR VARIOUS AIR POLLUTANTS

AIR STANDARDS, STUDIES AND COMPUTER SERVICES

ENVIRONMENTAL MANAGEMENT SERVICES

ENVIRONMENTAL MANAGEMENT DIVISION

PROVINCE OF MANITOBA

SCHEDULE "A"

AMBIENT AIR CRITERIA

For the air contaminants mentioned in column 1, the amount thereof in the atmosphere measured in accordance with columm 2 during the period of time set out in column 3, shall not be in greater concentration in the air than the amount shown in column 4 representing MAXIMUM ACCEPTABLE LEVEL deemed essential to provide adequate protection for soils, water, vegetation, materials, animals, visibility, personal comfort and well-being. The amount shown in column 5 represents the MAXIMUM DESIRABLE LEVEL which defines the long term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of Manitoba and for the continuing development of control technology.

ITEM	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	Name of Contaminant	Measurement of Concentration	Period of Time Contaminant is Measured	MAXIMUM ACCEPTABLE LEVEL Concentration	MAXIMUM DESIRABLE LEVEL Concentration
1 Manitoba Air Quality Objective	suspended particulate matter	micrograms per cubic meter of air	24-hour average annual geometric mean	120 70	60

ITEM	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	Name of Contaminant	Measurement of Concentration	Period of Time Contaminant is Measured	MAXIMUM ACCEPTABLE LEVEL Concentration	MAXIMUM DESIRABLE LEVEL Concentration
2 Manitoba Air Quality Guideline	soiling index	coefficient of haze per 1000 feet of air	24-hour average annual arithmetic mean	1.0 0.45	.45 0.3
3 Manitoba Air Quality Guideline	dustfall in excess of normal background levels	milligrams per square centimetre (tons per square mile per month)	air basin average 30 days single point 30 days	0.8 (22.8) 1.5 (42.8)	0.6 (17.1) 1.1 (31.4)
4 Manitoba Air Quality Objective	sulphur dioxide	micrograms per cubic meter (parts per million) of air	1-hour average 24-hour average annual arithmetic mean	900 (0.34) 300 (0.11) 60 (0.02)	450 (0.17) 150 (0.06) 30 (0.01)
5 Manitoba Air Quality Objective	carbon monoxide	milligrams per cubic metre (parts per million) of air	1-hour average 8-hour average	35 (30) 15 (13)	15 (13) 6 (5)
6 Manitoba Air Quality Objective	oxidants (ozone)	micrograms per cubic metre (parts per million) of air	1-hour average 24-hr. average annual arithmetic mean	160 (0.08) 50 (0.025) 30 (0.015)	100 (0.05) 30 (0.015)

ITEM	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	Name of Contaminant	Measurement of Concentration	Period of Time Contaminant is Measured	MAXIMUM ACCEPTABLE LEVEL Concentration	MAXIMUM DESIRABLE LEVEL Concentration
7 Manitoba Air Quality Objective	nitrogen dioxide	micrograms per cubic metre (parts per million) of air	1-hour average 24-hour average annual arithmetic mean	400 (0.213) 200 (0.106) 100 (0.053)	60 (0.032)
8 Manitoba Air Quality Guideline	hydrocarbons (non-methane)	micrograms per cubic metre (parts per million) of air	3-hour average	160 (0.24)	125 (0.19)
9 Manitoba Air Quality Guideline	hydrogen sulphide	micrograms per cubic meter (parts per million) of air	1-hour average 24-hour average	15 (0.011) 5 (0.004)	
10 Manitoba Air Quality Guideline	fluorides in air (as HF)	micrograms per cubic metre (parts per million) of air	24-hour average	0.85 (0.0010)	0.4 (0.0005)
11 Manitoba Air Quality Guideline	fluorides as gas (fluoridation)	micrograms per 100 square centimeters	30 days	40	

ITEM	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	Name of Contaminant	Measurement of Concentration	Period of Time Contaminant is Measured	MAXIMUM ACCEPTABLE LEVEL Concentration	MAXIMUM DESIRABLE LEVEL Concentration
12 Manitoba Air Quality Guideline	sulphation	milligrams of sulphur trioxide per 100 square centimeters per day	30 days	1.0	0.4
13 Manitoba Air Quality Guideline	lead	micrograms per cubic metre of air	24-hour average	5	
14 Manitoba Air Quality Guideline	beryllium	micrograms per cubic metre of air	24-hour average	0.01	
15 Manitoba Air Quality Guideline	odours	odour units	two tests not less than 15 minutes apart nor more than 60 minutes apart	Residential Zone one volume of odourous air diluted with one volume of odour free air (2) Industrial Zone one volume of odourous air diluted with six volumes of odour free air (7)	less than the odour threshold

ITEM	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	Name of Contaminant	Measurement of Concentration	Period of Time Contaminant is Measured	MAXIMUM ACCEPTABLE LEVEL Concentration	MAXIMUM DESIRABLE LEVEL Concentration
16 Manitoba Air Quality Guideline	ammonia	milligrams per cubic meter (parts per million) of air	1-hour average	1.4 (2)	

Note: Odours: Item 15
The release of offensive odours past the property line of any source shall be eliminated, or minimized, such that the said odours will not interfere with the comfort, well-being or enjoyment of any person. In most situations, achieving the Maximum Acceptable Level, will satisfy this condition.

B) POLLUTANTS

Pollutants monitored in the Manitoba Ambient Air Quality Network included:

Carbon Monoxide

Carbon monoxide (CO) is a colourless, odourless and tasteless gas slightly lighter than air. It is considered a dangerous asphyxiant because it combines strongly with the hemoglobin of the blood and reduces the blood's ability to carry oxygen to cell tissues. CO is a product of incomplete combustion of carbon and is emitted by fossil fuel combustion sources (i.e. motor vehicle). CO is measured on a continuous basis by the technique of non-dispersive infrared spectrometry and the data is generally reported in the unit form of hourly averages from which further time-weighting can be determined.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a reddish-brown gas with a pungent, irritating odour. It originates chiefly from combustion sources as well as from conversion of nitric oxide. Nitrogen dioxide exerts its primary toxic effect on the lungs and can be associated with increased susceptibility to respiratory infections and emphysematous changes. Nitrogen dioxide also suppresses vegetation growth, causes corrosion of metals, reduces visibility and acts as a

precursor with reactive hydrocarbons for oxidant formation. It is measured continuously by the technique of chemiluminescence with unit data reported as hourly averages.

The major role of nitrogen oxides in atmospheric photochemical reactions as in the formation of ozone is also recognized as is their significant contribution to the acid rain phenomenon.

Nitric Oxide

Nitric oxide (NO) is a colourless, odourless and tasteless gas which in nature is produced by biological action but in polluted atmospheres is produced primarily by fuel combustion in both stationary and mobile sources. By itself nitric oxide is not usually considered a pollutant but in a polluted atmosphere, it is readily oxidized to nitrogen dioxide through photochemical secondary reaction. Nitric oxide is measured concurrently with nitrogen dioxide by the technique of chemiluminescence and the data is processed as hourly averages.

Ozone

Ozone (O_3) is a pungent irritating gas formed at high altitudes by photochemical reaction involving molecular and atomic oxygen. Ozone and other oxidants are formed in polluted atmospheres as a result of a rather wide variety of photochemical reactions involving nitrogen oxides and reactive hydrocarbons. The overall effect of ozone is a stinging of the eyes and the mucous membranes.

It is also responsible for an increase in asthma effects and respiratory restriction. Ozone reduces vegetation yields, injures vegetation and weakens materials such as rubber and certain fabrics. Ozone is measured by use of the chemiluminescence technique and unit data reported as hourly averages.

Ammonia

Ammonia (NH_3) is a colourless gaseous alkaline compound of nitrogen and hydrogen. It is lighter than air, of extremely pungent smell and taste, and very soluble in water, and can be easily condensed by cold and pressure to a liquid. Ammonia can be an important industrial and agricultural compound as well as a nuisance, but it is not a major pollutant of the environment. It is used both free and combined in medicine, the arts and industry. Ammonia is measured continuously by the technique of chemiluminescence with unit data reported as hourly averages.

Hydrogen Sulphide

Hydrogen sulphide (H_2S) is a toxic, foul smelling gas well known for the rotten egg-like odour at a very low concentration. Hydrogen sulphide as an occasional air contaminant is almost always associated with some specific incident or industrial process. The concentration of hydrogen sulphide in the ambient air is rarely high enough to harm either vegetation or man. However, at high concentrations, it will produce loss of sense of smell, severe respiratory tract irritation and material damage such as the staining

of lead based paints. H_2S is measured continuously by techniques such as coulometry and automated colorimetric impingement. Unit data is reported as hourly averages.

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas with a pungent irritating odour emitted primarily from the combustion of fossil fuels containing sulphur, and from primary copper and nickel smelting. It is usually recognized as one of the major atmospheric pollutants. Sulphur dioxide produces an increased frequency of respiratory disease symptoms and lung disease. It also produces marked effects on vegetation, corrodes materials and may oxidize in the atmosphere to form sulphuric acid and sulphates. Sulphur dioxide along with nitrogen dioxide has been determined to contribute to acid rain.

Sulphur dioxide is measured by use of the coulometry and pulsed fluorescence techniques. Unit data is reported as hourly averages.

Soiling Index (Smoke)

Soiling index (COH) is an indication of the soiling or darkening potential of fine particulate in the atmosphere usually resulting from combustion. These particles are usually in the size range of 0.1 to 1 micron in diameter. A tape sampler is used to collect the "smoke" particles on a filter paper and the degree of light transmission on an hourly or bi-hourly basis is reported as Coefficient of Haze (COH) units.

Total Suspended Particulate

Total Suspended Particulate (TSP) is a general term which applies to a large variety of solid or liquid particles of a size and configuration such that they remain suspended in the air and can be drawn into the respiratory passages. These types of particles usually in the size range of 0.1 to 100 microns may originate as a result of industrial processes, human activities and from natural sources such as wind swept or entrained dust. By itself, or in association with other pollutants, TSP, in enough concentration, may injure the respiratory system. TSP also may reduce visibility and contribute to property damage and soiling. A high volume air sampler is used to collect the particles on a glass fibre filter and results are reported as integrated 24-hour concentration of mass per volume of air.

Lead

Lead (Pb) exists in the atmosphere primarily as a particulate resulting from the combustion of leaded gasoline and from certain source industries. Exposure to lead will adversely affect human health (especially young children) by absorption into the bloodstream and impairment of heme synthesis in cells. Other adverse effects associated with elevated blood lead levels include the possibility that nervous system damage may occur. Lead is analyzed from a representative portion of the total suspended particulate collected by high volume sampling. Air concentrations are reported as integrated 24-hour concentrations of mass of lead per volume of air.

Sulphates

Sulphates (SO_4) in the atmosphere are primarily in the form of aerosols such as sulphuric acid and in particulates such as compounds of ammonium and zinc sulphates. Particulate sulphates can arise as a result of hydrogen sulphide oxidation and from sea spray, but are primarily formed from the oxidation of sulphur dioxide. Sulphates can impact on health as small particulate which enter the respiratory system and have been associated as a major contributing factor to visibility reduction. Sulphates are measured as a constituent of total suspended particulate.

Nitrates

Nitrates (NO_3) in the atmosphere can be in the form of aerosols, gases, and particulate. The nitrate ion is the most oxidized form of nitrogen and the nitrate salts of all common metals are quite water soluble. Particulate nitrate are believed to contribute to atmospheric haze. Particulate nitrate (and sulphates) may be a major part of dry atmospheric acidic deposition. Reported nitrate levels are particulate nitrate determined as a constituent of total suspended particulate.

Dustfall

Dustfall refers to a particulate sample collected after airborne particles settle by sedimentation into dustfall canisters. The dustfall measurement is an indication of the quantity of larger particles (usually larger than 10 microns) having appreciable settling

velocities and relatively short atmospheric residence times. The primary effect of these larger particles is a nuisance effect due to their visual presence. Dustfall is expressed as a deposition rate in units of tons per square mile per 30-day period.

Sulphation

Sulphation rate measurement is a relative index of activity of airborne sulphur oxides and sulphates. Sulphation is measured by exposing a lead dioxide paste in an inverted petri dish for about 30 days. The amount of sulphate formed is determined and converted to milligrams of sulphur trioxide per 100 square centimeters per day.

C) SAMPLING SITES

Figure 1 is a map of the urban areas included in the Manitoba Ambient Air Quality Monitoring Network. Figures 2 through 6 depict the monitoring locations within each of the urban centres.

Air monitoring stations are listed in a more detailed form in Table 2 as to location, code number, pollutants monitored, and period during 1984 that monitoring took place.

Table 2: Ambient Air Monitoring Sites (1984)

AREA	CODE	SAMPLING SITE LOCATION	SAMPLE PERIOD	POLLUTANTS MONITORED
Winnipeg (Downtown)	9119	65 Ellen Street	Jan. - Dec.	SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4, NO_3
Winnipeg (Residential)	9118	299 Scotia Street	Jan. - Dec.	SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4, NO_3
	9120	604 St. Mary's Road	Jan. - Dec.	SO_2, CO, O_3, COH, TSP, Pb, SO_4, NO_3
Winnipeg (Industrial)	9104	800 Marion Street	Jan. - May	TSP, Pb, SO_4, NO_3
Winnipeg (Roadside)	2011	1350 Pembina Highway	Jan. - Apr.	TSP, Pb
	9102	2120 Portage Avenue	Jan. - Dec.	TSP, Pb, SO_4, NO_3
St. Francois Xavier (Winnipeg Background)	4304	MTS Trailer	Jan. - Dec.	TSP, Pb
Brandon (Downtown)	9201	11th St. & Princess	Jan. - Dec.	TSP, Pb, SO_4, NO_3
Brandon (Industrial)	5131	Assiniboine Community College (Lot)	Jan. - Dec. Jan. - June Jan. - Mar.	NH_3, NO_2, NO, O_3, SO_2 TSP, Pb, SO_4, NO_3
The Pas	7111	3rd & Ross (Provincial Building)	Jan. - Dec.	H_2S (TRS)
Flin Flon	7211 7233	55 Main Street 35 Main Street	Jan. - Aug. Aug. - Dec.	SO_2
	7222	Channing Drive	Jan. - Dec.	SO_2

Table 2: Ambient Air Monitoring Sites (1984) Con't

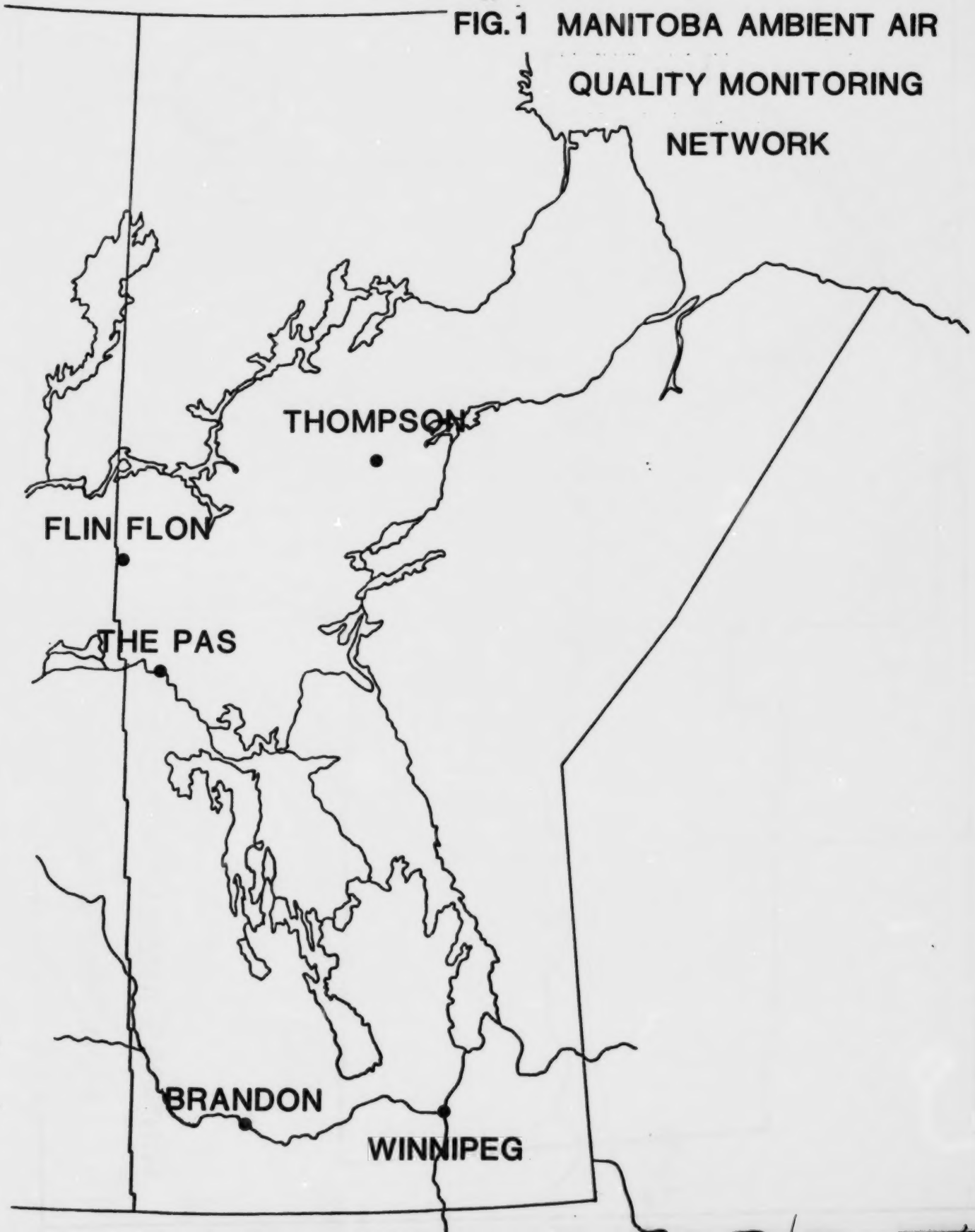
Thompson	7344	59 Elizabeth Road	Jan. - Dec.	SO_2

* Winnipeg Dustfall and Sulphation Sites:
1) Martin Street and Henderson Highway
2) Windermere and Rockman
3) Portage at Minto
4) Smith and King

* Winnipeg Dustfall and Sulphation Background Site:
Experimental Research Farm - Morden

* As a result of program review and changing priorities the monitoring of these parameters ceased in May, 1984

FIG. 1 MANITOBA AMBIENT AIR QUALITY MONITORING NETWORK



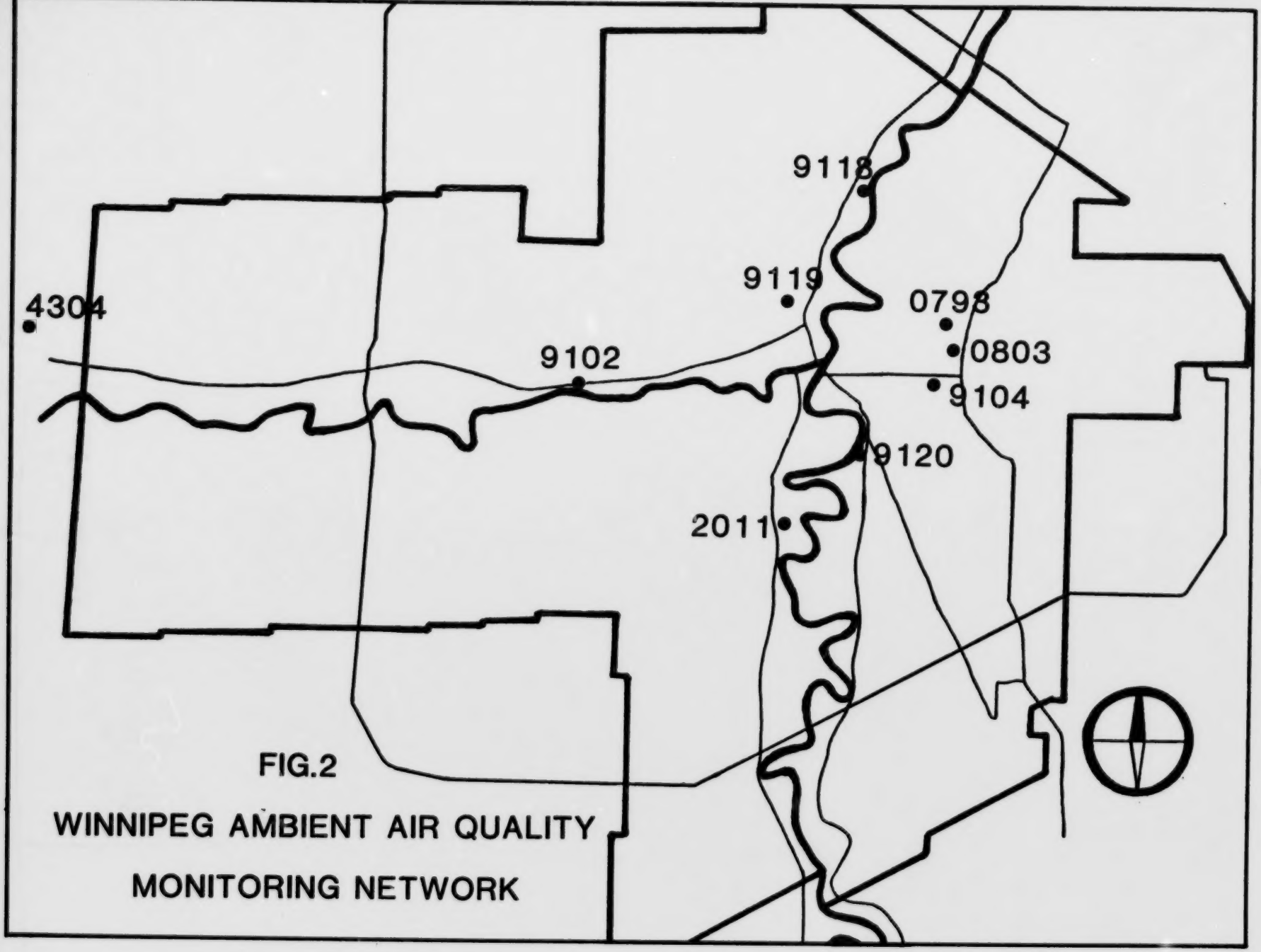


FIG.2

WINNIPEG AMBIENT AIR QUALITY MONITORING NETWORK

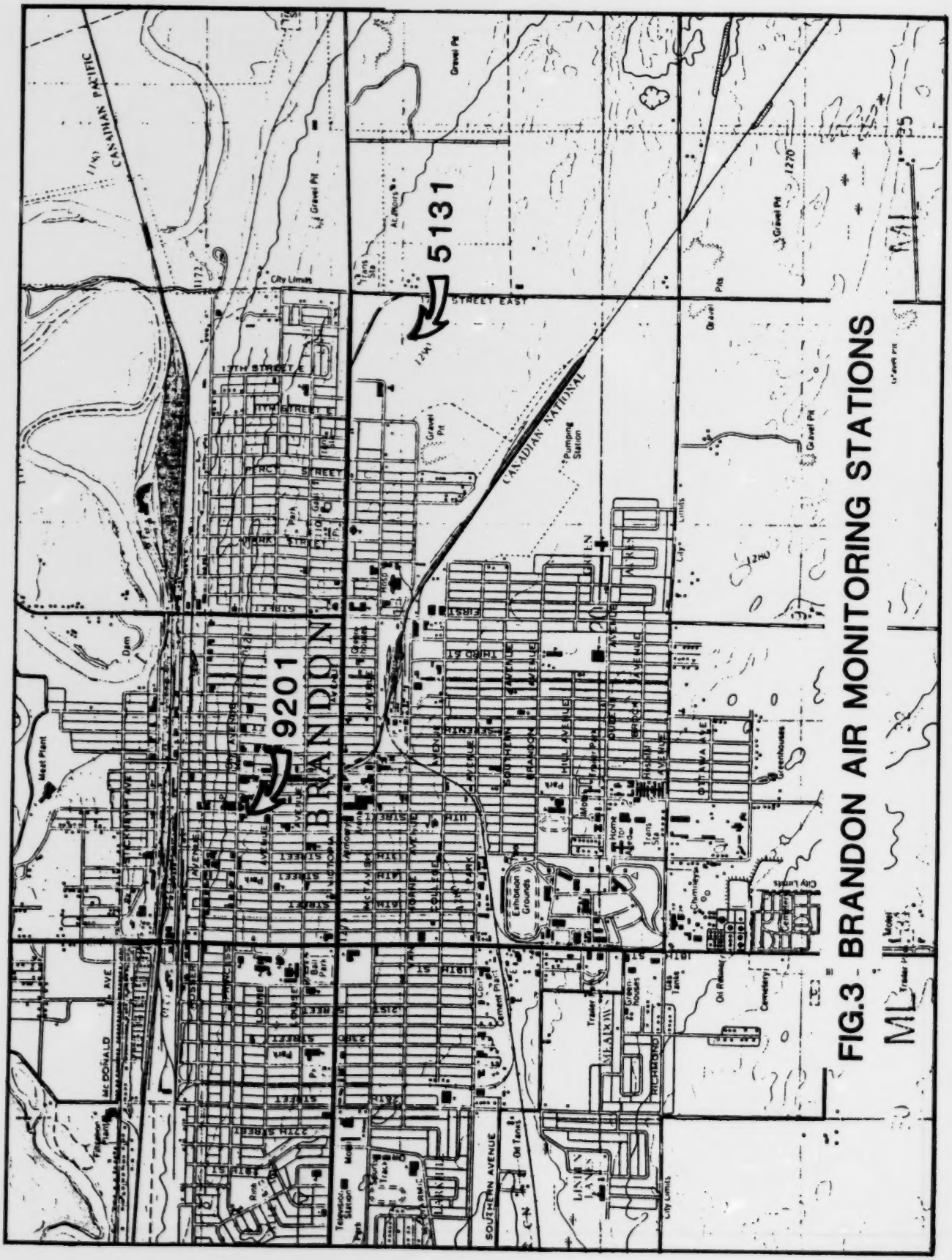
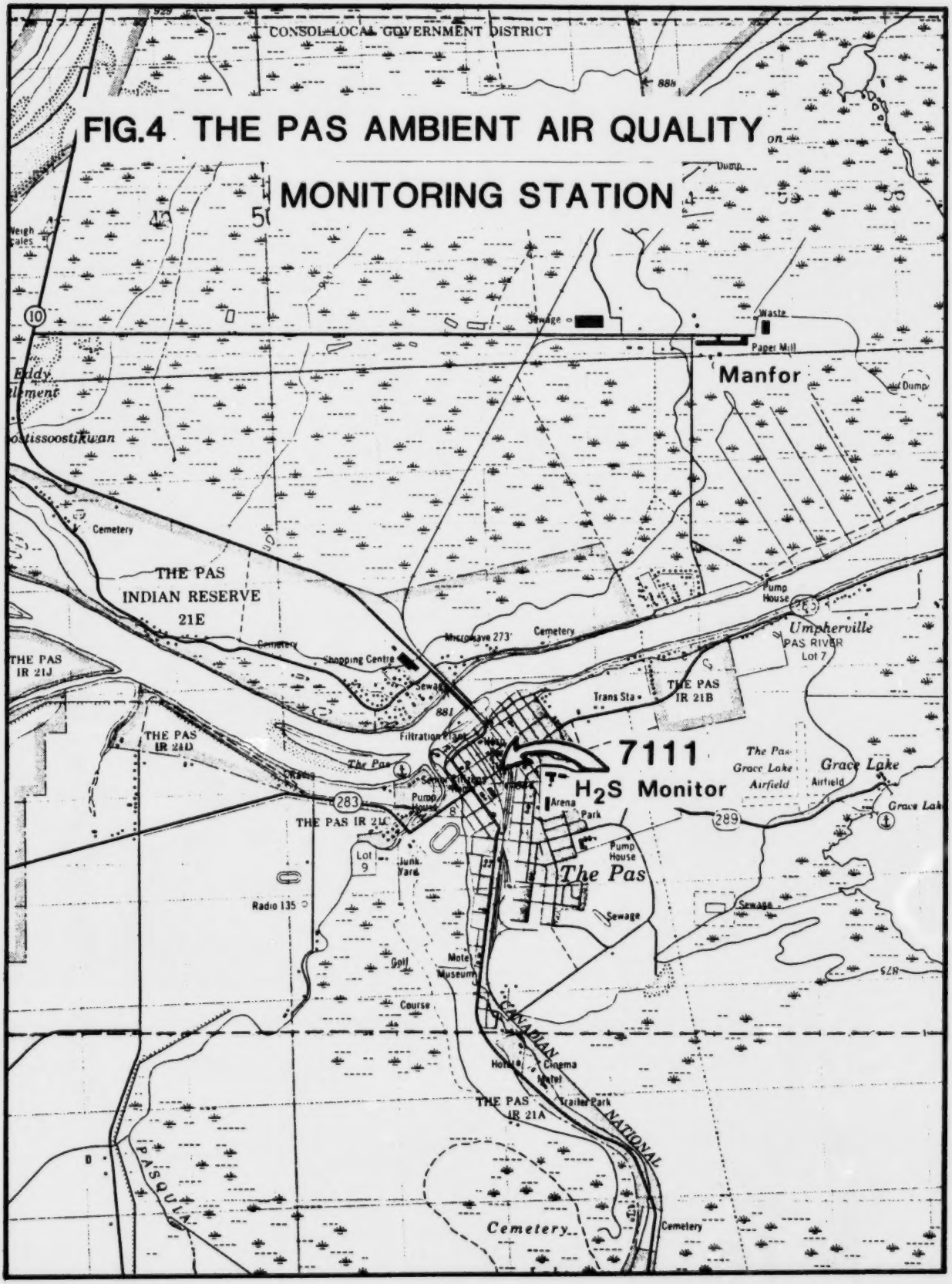


FIG.3 - BRANDON AIR MONITORING STATIONS


CONSOL-LOCAL GOVERNMENT DISTRICT
FIG.4 THE PAS AMBIENT AIR QUALITY
MONITORING STATION
Manfor
Paper Mill
Waste
Sewage
Dump
Cemetery
THE PAS
INDIAN RESERVE
21E
THE PAS
IR 21J
THE PAS
IR 21D
THE PAS IR 21C
THE PAS
IR 21B
THE PAS
IR 21A
Umpherville
PAS RIVER
Lot 7
Shopping Centre
Trans Sta
Filtration Plant
7111
H2S Monitor
The Pas
Grace Lake
Airfield
Arena
Park
Pump
House
Lot
9
Junk
Yard
Radio 135
Golf
Course
Motel
Museum
Hotel
Cinema
Trailer Park
CANADIAN NATIONAL
PASQUIA
Cemetery
283
289
10

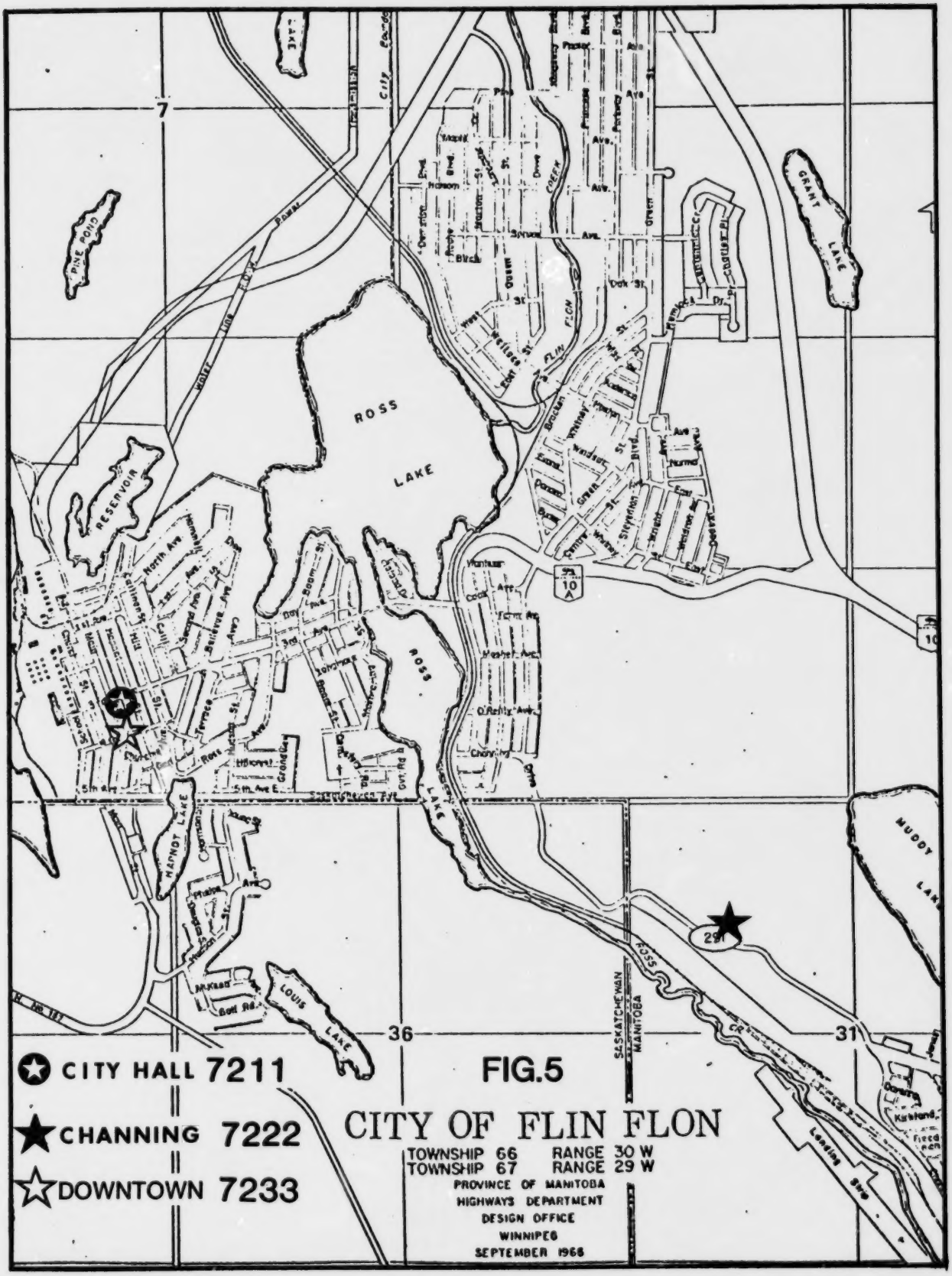
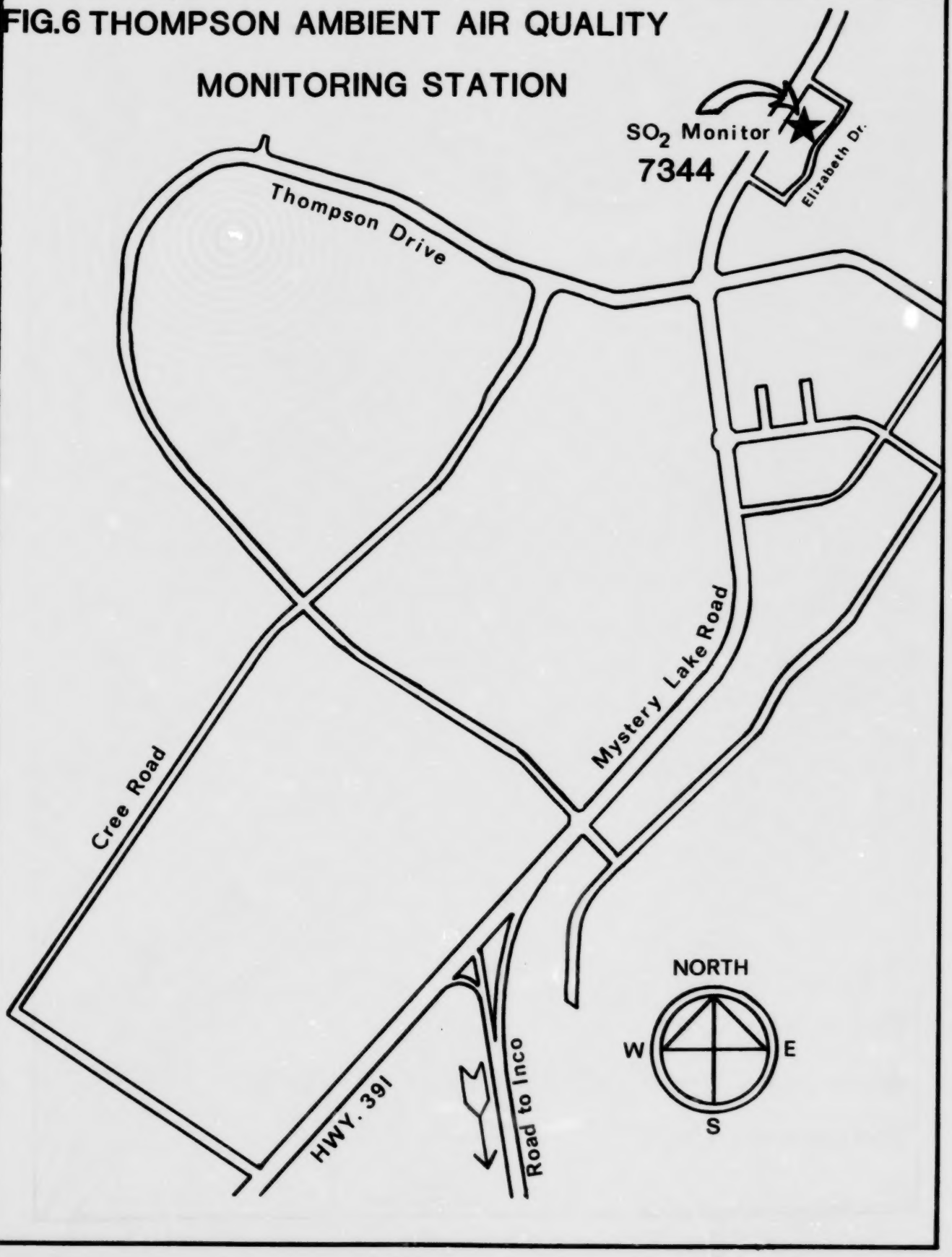

7
ROSS LAKE
RESERVOIR
PINE POND
GRANT LAKE
MUDDY LAKE
LOUIS LAKE
HARNOT LAKE
36
31
29
10A
CITY HALL 7211
CHANNING 7222
DOWNTOWN 7233
FIG.5
CITY OF FLIN FLON
TOWNSHIP 66 RANGE 30 W
TOWNSHIP 67 RANGE 29 W
PROVINCE OF MANITOBA
HIGHWAYS DEPARTMENT
DESIGN OFFICE
WINNIPEG
SEPTEMBER 1968

FIG.6 THOMPSON AMBIENT AIR QUALITY MONITORING STATION



D) AIR QUALITY INDEX

A Canadian Annual Index of Air Quality has been developed and is used by several jurisdictions to report on air quality.

An air quality index transforms the values of individual air pollution related parameters into a single number or descriptive term in order to:

1. indicate air quality trends
2. permit comparisons of the air quality in different urban areas, and
3. provide a single value indicator of air quality for socio-economic modelling.

Determination of the Index

The concentrations of individual pollutants are converted to a common scale (the pollutant-index scale). The scale is designed such that a value of 0 corresponds to zero concentration, a value of 25 to a concentration equal to the Maximum Desirable Objective, a value of 50 to the Maximum Acceptable Objective, and a value of 100 to the Maximum Tolerable Objective. These points are joined by straight lines. When one or two of the objectives have not been specified for a particular pollutant and averaging time, or the concentration is outside the available objectives, the pollutant-index is determined by linear interpolation or extrapolation.

Using the scale generated above, the 98th percentile concentrations (concentrations exceeded only two (2) per cent of the time) are converted to pollutant-indices.

Where more than one pollutant-index has been computed for a given pollutant, the largest pollutant-index is used to represent that pollutant. The arithmetic mean of the three highest pollutant-indices is then calculated and used as the numerical value of the Canadian Annual Index of Air Quality. The air quality can also be described verbally according to the following scale:

Description	Numerical Values
GOOD	0 - 25
FAIR	26 - 50
POOR	51 - 100
VERY POOR	101 +

The following assumptions have been made in the design and use of this index:

1) The index will be based on valid air quality data from monitoring stations that meet the Class 1 requirements of the National Air Pollution Surveillance (NAPS) Network. A Class 1 air quality monitoring station is one where all air quality objective parameters (within reason) are measured continuously. These stations monitor air quality trends and thus require a certain permanency in operation and siting. They serve primarily to evaluate progress in the control of air pollution on a national basis and are fundamentally population oriented.
2) At the defined objective levels (Desirable, Acceptable and Tolerable), the effects of all pollutants have equal importance with respect to the quality of the air.

3) The index is based on the average of the three (3) different pollutants that have the most significant effect on the environment during a given year. This method was found to best represent actual quality and changes in air quality on an annual basis.

4) The index is based on the measured levels of air quality that are not exceeded more than two (2) per cent of the time as recommended by the World Health Organization.

Indices are only presented for stations 9118 (299 Scotia St., Winnipeg), 9119 (65 Ellen St., Winnipeg) and 9120 (604 St. Mary's Rd., Winnipeg) due to the Class 1 requirement. Station 9120 does not strictly qualify as a Class 1 station but fulfills most of the requirements and therefore is included.

The site specific indices are listed in Table 8.

RESULTS

EXPLANATION OF DATA STATISTICS

The summary statistics that appear on Tables 3 to 7 are designed to outline in brief a profile of air pollutant concentration levels at specific sites with comparison to Manitoba Air Quality criteria.

Each pollutant is addressed by name and a unique pollutant number. Immediately below the pollutant is the indication of the units in which the air pollutant concentration levels are reported. Each air sampling site is identified by a station number and location. More information on the specific sampling site can be found by referring to Table 2.

The quantity of data available from which the calculated statistics are drawn is indicated by the two following references:

"# of months of data" - this refers to the number of months in the year for which at least 75% of the data are valid and available (NOT applicable to non-continuous measurements such as TSP, Pb, dustfall, sulphation).

"Percent of data available" - this refers to the percentage of unit data (e.g. hourly averages) per year that are valid and available.

These two statistics are reflective of representativeness of the data statistics for that year. To representatively reflect annual air quality, two months of each quarter and 75% of the total annual data should be available for statistical calculation.

The "Percentile Distribution" is the data distribution of the unit data as shown (i.e. hourly for most pollutants except bi-hourly for COH, 24-hour integrated samples for TSP and Pb). The p^{th} percentile (e.g. 10%) is the pollutant concentration such that p% (e.g. 10%) of the data values are less than that indicated value of pollutant concentration and (100-p)% (e.g. 90%) is greater.

The annual mean is an arithmetic mean (unless otherwise shown) of the available unit data values. The maximum data values are the highest levels present or calculated for the time period listed within the shown year. Other than for the unit data, longer time-based averages are arithmetic and are running averages of consecutive unit data and can overlap for days and/or months. For example, 24-hour running samples are based on increments of one hour and could result in a maximum of 24 x 31 x 12 = 8928 - 24-hour sampling periods within a year. At least 75% of the data values within one running period must be available for the calculation of that running mean average.

A comparison of the data to the Manitoba Ambient Air Criteria (Appendix A) is shown under the heading "# of samples above M.D.L" or "..... above M.A.L.". This listing is a count of the number of time-based averages or unit data concentrations that are larger than the appropriate time-based objective or guideline level.

Dustfall and sulphation data statistics are shown as an average of individual sites and labelled as a Winnipeg air basin average relative to a control area (Morden). The monthly air basin averages are shown and comparison to the appropriate time-based criteria is shown (Table 7).

The 1984 data statistics for the Manitoba air quality monitoring network are on Tables 3 to 7.

Table 3

MANITOBA AMBIENT AIR QUALITY DATA -- ANNUAL POLLUTANT SUMMARY

CARBON MONOXIDE (CO), #629
PARTS PER MILLION (PPM)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	8-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	8-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	8-HR
9118	WINNIPEG, SCOTIA & JEFFERSON	11	89.1	0.0	0.2	0.3	0.5	1.0	2.6	0.5	6.3	3.0	0	0	0	0
9119	WINNIPEG, 65 ELLEN STREET	8	70.1	0.0	0.3	0.5	0.9	1.8	5.1	0.8	15.0	7.4	1	35	0	0
9120	WINNIPEG, 604 ST. MARY'S ROAD	12	94.2	0.0	0.2	0.3	0.5	1.1	4.1	0.5	11.3	6.2	0	15	0	0

NITROGEN DIOXIDE (NO_2), #759
PARTS PER HUNDRED MILLION (PPHM)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	8-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	11	87.6	0.0	0.1	0.4	0.8	1.6	3.1	0.6	18.4	2.5			0	0
9118	WINNIPEG, SCOTIA & JEFFERSON	8	73.2	0.3	0.7	1.0	1.1	1.7	2.9	1.0	6.1	2.8			0	0
9119	WINNIPEG, 65 ELLEN STREET	8	70.2	0.2	1.0	1.4	2.0	3.2	5.3	1.6	10.2	5.1			0	0

NITRIC OXIDE (NO), #769
PARTS PER HUNDRED MILLION (PPHM)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	10	88.0	0.0	0.0	0.0	0.0	1.0	5.1	0.4	53.6	7.3				

Table 4

MANITOBA AMBIENT AIR QUALITY DATA -- ANNUAL POLLUTANT SUMMARY

OXIDANTS (OZONE) (O_3), #829
PARTS PER HUNDRED MILLION (PPHM)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR. LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	12	92.6	1.1	2.1	2.7	3.3	4.4	6.0	2.7	12.2	5.1	401	8058	21	4782
9118	WINNIPEG, SCOTIA & JEFFERSON	5	42.6	0.1	0.6	1.3	1.8	2.8	4.4	1.4	13.0	3.5	14	1421	2	246
9119	WINNIPEG, 65 ELLEN STREET	6	59.5	0.0	0.5	1.0	1.6	2.9	4.6	1.3	8.3	7.0	35	1610	1	396
9120	WINNIPEG, 604 ST. MARY'S ROAD	11	92.8	0.2	1.3	2.1	2.8	3.9	5.4	2.1	12.0	4.6	134	6333	1	2244

AMMONIA (NH_3), #789
PARTS PER MILLION (PPM)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR. LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	11	90.4	0.0	0.0	0.0	0.0	0.0	1.9	0.1	5.9	1.3			71	

HYDROGEN SULPHIDE (H_2S), #1619
PARTS PER BILLION (PPB)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR. LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR
793	WINNIPEG, 1011 MISSION STREET	0	1.0	0	0	0	0	0	0	0	0	0			0	0
7111	THE PAS, PROVINCIAL BLDG.	5	57.3	0	0	0	0	0	4	0	19	5			6	10

Table 5

MANITOBA AMBIENT AIR QUALITY DATA -- ANNUAL POLLUTANT SUMMARY

SULPHUR DIOXIDE (SO_2), #1629
PARTS PER MILLION (PPM)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (1-HR LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 1-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 1-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 1-HR	24-HR
793	WINNIPEG, 1011 MISSION STREET	1	7.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0	0	0	0
803	WINNIPEG, PANET & FOURNIER	0	1.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	4	40.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0	0	0	0
7211	FLIN FLON, CITY HALL	5	47.6	0.00	0.00	0.00	0.00	0.00	0.15	0.01	0.61	0.10	34	40	3	0
7222	FLIN FLON, CHANNING DRIVE	11	86.0	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.64	0.07	32	15	5	0
7233	FLIN FLON, 35 MAIN ST.	4	33.6	0.00	0.00	0.00	0.00	0.00	0.14	0.01	0.50	0.14	18	29	1	9
7344	THOMPSON, 59 ELIZABETH ROAD	9	79.1	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.69	0.18	66	114	19	37
9118	WINNIPEG, SCOTIA & JEFFERSON	9	84.0	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.02	0	0	0	0
9119	WINNIPEG, 65 ELLEN STREET	9	78.1	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.14	0.02	0	0	0	0
9120	WINNIPEG, 604 ST. MARY'S ROAD	10	87.7	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.30	0.02	1	0	0	0

SOILING INDEX (SMOKE), #9709
COEFFICIENT OF HAZE UNITS PER 1000 FEET (COH)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (2-HR LEVELS) 10%	30%	50%	70%	90%	99%	ANNUAL MEAN	MAXIMUM DATA VALUES 2-HR	24-HR	# OF SAMPLES ABOVE M.D.L. 2-HR	24-HR	# OF SAMPLES ABOVE M.A.L. 2-HR	24-HR
9118	WINNIPEG, SCOTIA & JEFFERSON	10	89.5	0.0	0.0	0.0	0.1	0.2	0.4	0.1	1.1	0.4		0		0
9119	WINNIPEG, 65 ELLEN STREET	9	83.8	0.0	0.1	0.1	0.2	0.3	0.7	0.2	2.4	0.9		0		0
9120	WINNIPEG, 604 ST. MARY'S ROAD	12	98.0	0.0	0.0	0.0	0.1	0.1	0.4	0.0	1.1	0.3		0		0

TOTAL SUSPENDED PARTICULATE (TSP), #1089
MICROGRAMS PER CUBIC METRE (ug/m^3)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR	# OF SAMPLES ABOVE M.A.L. 24-HOUR
2011	WINNIPEG, 1350 PEMBINA HIGHWAY	0	4.4	28	31	39	55	68	129	42	138	1
4304	ST. FRANCOIS XAVIER, MTS TRAILER	0	15.8	6	14	18	26	45	160	17	161	2
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	0	3.8	9	16	23	26	42	60	21	63	0
9102	WINNIPEG, 2120 PORTAGE AVENUE	0	15.8	20	31	45	58	90	153	43	190	2
9104	WINNIPEG, 800 MARION STREET	0	5.2	25	35	60	74	92	120	49	123	1
9118	WINNIPEG, 299 SCOTIA STREET	0	16.1	14	25	31	43	87	188	31	194	2
9119	WINNIPEG, 65 ELLEN STREET	0	15.6	27	42	55	74	200	465	58	421	10
9120	WINNIPEG, 604 ST. MARY'S ROAD	0	15.6	18	27	35	54	90	176	40	186	5
9201	BRANDON, 1104 PRINCESS AVENUE	0	15.6	18	26	46	60	77	158	41	161	3

Table 6

MANITOBA AMBIENT AIR QUALITY DATA -- ANNUAL POLLUTANT SUMMARY

LEAD (Pb), #8219
MICROGRAMS PER CUBIC METRE (ug/m^3)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR.	24-HR.	# OF SAMPLES ABOVE M.A.L. 24-HOUR
2011	WINNIPEG, 1350 PEMBINA HIGHWAY	0	4.4	0.08	0.12	0.21	0.24	0.36	0.41	0.17	0.41	0.41	0
4304	ST. FRANCOIS XAVIER, MTS TRAILER	0	15.8	0.03	0.03	0.04	0.05	0.06	0.12	0.04	0.12	0.12	0
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	0	3.8	0.03	0.06	0.07	0.09	0.14	0.18	0.07	0.19	0.19	0
9102	WINNIPEG, 2120 PORTAGE AVENUE	0	16.1	0.05	0.14	0.20	0.27	0.41	0.81	0.19	1.11	1.11	0
9104	WINNIPEG, 800 MARION STREET	0	5.2	0.07	0.08	0.12	0.15	0.24	0.36	0.12	0.39	0.39	0
9118	WINNIPEG, 299 SCOTIA STREET	0	15.8	0.05	0.07	0.10	0.17	0.28	0.60	0.11	0.79	0.79	0
9119	WINNIPEG, 65 ELLEN STREET	0	15.3	0.12	0.15	0.20	0.24	0.38	0.97	0.21	1.51	1.51	0
9120	WINNIPEG, 604 ST. MARY'S ROAD	0	15.6	0.06	0.11	0.16	0.21	0.34	0.50	0.15	0.54	0.54	0
9201	BRANDON, 1104 PRINCESS AVENUE	0	15.6	0.07	0.10	0.12	0.15	0.24	0.38	0.13	0.41	0.41	0

SULFATES (SO_4), #1639
MICROGRAMS PER CUBIC METRE (ug/m^3)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR.	24-HR.	# OF SAMPLES ABOVE M.A.L. 24-HOUR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	0	3.8	2.1	2.8	3.2	4.4	5.0	8.2	3.3	8.7	8.7	
9102	WINNIPEG, 2120 PORTAGE AVENUE	0	16.1	0.6	1.0	1.9	3.0	4.6	8.7	2.5	12.2	0.0	
9104	WINNIPEG, 800 MARION STREET	0	5.2	1.4	2.3	3.0	4.7	7.7	9.0	3.2	9.2	9.2	
9118	WINNIPEG, 299 SCOTIA STREET	0	15.8	0.5	1.1	1.6	2.2	4.3	11.7	2.1	15.1	0.0	
9119	WINNIPEG, 65 ELLEN STREET	0	15.0	0.8	1.5	2.7	3.7	6.1	12.6	2.4	15.3	15.3	
9120	WINNIPEG, 604 ST. MARY'S ROAD	0	15.6	0.6	1.0	2.4	3.3	6.2	10.7	2.0	14.2	14.2	
9201	BRANDON, 1104 PRINCESS AVENUE	0	15.6	0.5	1.0	1.7	2.9	4.6	8.9	1.5	9.1	9.2	

NITRATES (NO_3), #0779
MICROGRAMS PER CUBIC METRE (ug/m^3)

1984

STATION NUMBER	STATION LOCATION	# OF MONTHS AVAIL.	PERCENT OF DATA AVAIL.	PERCENTILE DISTRIBUTION (24-HR INTEGRATED) 10%	30%	50%	70%	90%	99%	ANNUAL GEOMETRIC MEAN	MAXIMUM DATA VALUES 24-HR.	24-HR.	# OF SAMPLES ABOVE M.A.L. 24-HOUR
5131	BRANDON, ASSIN. COMMUNITY COLLEGE	0	3.8	0.9	1.4	1.8	3.3	7.0	8.3	2.1	8.5	8.5	
9102	WINNIPEG, 2120 PORTAGE AVENUE	0	16.1	0.3	0.5	0.9	1.2	3.0	7.6	0.8	9.7	9.7	
9104	WINNIPEG, 800 MARION STREET	0	5.2	0.6	0.9	1.3	2.0	3.7	5.0	1.3	5.2	5.2	
9118	WINNIPEG, 299 SCOTIA STREET	0	15.8	0.2	0.3	0.5	0.8	2.7	7.6	0.5	8.1	8.1	
9119	WINNIPEG, 65 ELLEN STREET	0	15.0	0.3	0.6	0.8	1.5	3.6	9.4	0.9	11.4	11.4	
9120	WINNIPEG, 604 ST. MARY'S ROAD	0	15.6	0.2	0.5	0.7	1.4	3.4	8.2	0.9	10.0	10.0	
9201	BRANDON, 1104 PRINCESS AVENUE	0	15.6	0.2	0.4	0.7	1.4	3.2	6.4	0.7	6.9	6.9	

Table 7

MANITOBA AMBIENT AIR QUALITY DATA - ANNUAL POLLUTANT SUMMARY

DUSTFALL (TOTAL SOLIDS)
TONS PER SQUARE MILE PER 30 DAYS

1984

LOCATION	30 DAY INTEGRATED SAMPLES MONTHLY AVERAGES				# OF MONTHLY AVERAGES ABOVE CRITERIA		# OF SAMPLES ABOVE SITE CRITERIA	
	JAN.	FEB.	MAR.	APR.	M.D.L.	M.A.L.	M.D.L.	M.A.L.
WINNIPEG AIR BASIN AVERAGE (5 SITES) (ABOVE BACKGROUND)	7.1	below background	19.1	29.9	2	1	3	2
BACKGROUND (MORDEN)	10.4	37.7	38.2	10.0			2	0

SULPHATION
MILLIGRAMS SO_3 per 100 CM^2 PER DAY

1984

LOCATION	30 DAY INTEGRATED SAMPLES MONTHLY AVERAGES				# OF SAMPLES ABOVE 30-DAY AVG. CRITERIA	
	JAN.	FEB.	MAR.	APR.	M.D.L.	M.A.L.
WINNIPEG AIR BASIN AVERAGE (5 SITES)	0.1	0.1	0	0.1	0	0
BACKGROUND (MORDEN)	0	0	0	0	0	0

Table 8: 1984 Air Quality Indexes

Station Code and Location	Pollutant	Averaging Time	98th %	Pollutant Index	Descriptor	Station Mean
9118	CO	1-hr.	2.0 ppm	4	Good	
299 Scotia St.	CO	8-hr.	1.7 ppm	8	Good	
Winnipeg	NO_2	1-hr.	2.5 ppm	5.5	Good	
	NO_2	24-hr.	2.0 pphm	10	Good	
	O_3	1-hr.	4.1 pphm	22.5	Good	30.5
	O_3	24-hr.	3.2 pphm	-	-	FAIR
	TSP	24-hr.	170 $\mu g/m^3$	59	Poor	
	SO_2	1-hr.	0.00 ppm		Good	
	SO_2	24-hr.	0.2 pphm	0.5	Good	
9119	CO	1-hr.	3.8 ppm	8.5	Good	
65 Ellen St.	CO	8-hr.	3.1 ppm	14	Good	
Winnipeg	NO_2	1-hr.	4.8 pphm	11.5	Good	
	NO_2	24-hr.	3.7 pphm	17.5	Good	
	O_3	1-hr.	4.1 pphm	22.5	Good	46
	O_3	24-hr.	3.4 pphm	-	-	Fair
	TSP	24-hr.	398 $\mu g/m^3$	99	Poor	
	SO_2	1-hr.	0.01 ppm		Good	
	SO_2	24-hr.	0.5 pphm	1.5	Good	
9120	CO	1-hr.	2.8 ppm	5.5	Good	
604 St. Mary's Rd.	CO	8-hr.	2.5 ppm	11.5	Good	
Winnipeg	O_3	1-hr.	5.0 pphm	26.5	Fair	
	O_3	24-hr.	3.7 pphm	-	-	32
	TSP	24-hr.	169 $\mu g/m^3$	59	Poor	Fair
	SO_2	1-hr.	0.00 ppm		Good	
	SO_2	24-hr.	0.4 pphm	1.3	Good	

DISCUSSION

Winnipeg Air Quality

Downtown: The downtown monitoring station, 9119, at 65 Ellen Street measured levels of SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4 and NO_3.

Sulphur Dioxide (SO_2) levels downtown continue to be well below the Manitoba Air Quality Objective levels and there were no excursions above the one-hour or 24-hour Maximum Desirable or Maximum Acceptable Levels during 1985 (Table 5). The maximum 1-hour data value recorded was 0.14 ppm SO_2 and the maximum 24-hour value was 0.2 ppm SO_2.

Carbon Monoxide (CO) levels at station 9119 appear higher than at the two Winnipeg residential sites 9118, 9120 (Table 3 and Figures 7 and 8). Levels also appear to be higher than those measured during 1983. The annual mean is higher, all percentile distribution values are higher, the maximum data values are higher and where there were zero excursions above the 1-hour Maximum Desirable Level (M.D.L.) of 13 ppm and the 8-hour M.D.L. of 5 ppm during 1983, there were 1 and 35 excursions respectively during 1984.

The maximum 1-hour data value was 15.0 ppm and 7.4 ppm over 8-hours.

There was an increase in CO levels during September and October as was observed in 1983 probably due to smoke from the burning of stubble on agricultural land surrounding the city.

Nitrogen Dioxide (NO_2) levels continue to be well below the Manitoba Air Quality Objectives at station 9119. There were no values above the 1-hour M.A.L. (0.213 ppm) or the 24-hour M.A.L. (0.106 ppm). The maximum values recorded were 0.102 ppm for one hour and 0.051 ppm for twenty-four hours.

Ozone (O_3) levels in downtown Winnipeg appear similar to those at one of the residential stations (9118) but lower than at the other residential station (9120), although comparisons are difficult due to the lack of complete data from stations 9118 and 9119 (Table 4).

There continue to be frequent excursions above the 24-hour time-based ojective levels but less than during the 1983 reporting period. The 1-hour MAL was exceeded once each at 9119 and 9120; two elevated hours were recorded at 9118.

The maximum 1-hour ozone value was 8.3 pphm and the maximum 24-hour value was 7.0 pphm.

Soiling Index values as measured by Coefficient of Haze (COH) units per 1000 feet are again higher downtown than at the two residential stations (Table 5). There were 6, 24-hour average readings above the Maximum Desirable Level (MDL) of 0.45, but none rose above the Maximum Acceptable Level (MAL) of 1.0. All six levels above the 24-hour MDL occurred on the fifth day of September, a day characterized by Environment Canada as having "severely reduced visibility and smoke from brush fires".

The maximum 2-hour value recorded was 2.4 COH units/1000 feet and the maximum 24-hour value was 0.9 COH units/1000 feet.

Total Suspended Particulates (TSP) in downtown Winnipeg appear to be a greater problem than at any of the other stations where this parameter is measured. The 90th and 99th percentile levels are at least twice as high as all other stations and the most excursions above the 120 $\mu g/m^3$ MAL were recorded downtown (10) (Table 5). High TSP levels at this station relate to the amount of vehicular traffic encountered in this area. The maximum 24-hour TSP value was 421 micrograms per cubic metre recorded on Friday, May 18. Environment Canada records for this period indicate moderate winds, severe forest fires and blowing dust. All other stations experienced high TSP values for this period, including the rural background and Brandon stations.

Lead (Pb) levels at station 9119 and at all stations monitoring Pb do not approach the MAL of 5.0 micrograms per cubic metre of air. Station 9119 does have the highest lead levels followed closely by the two other Winnipeg stations located near major traffic arteries (2011 and 9102). The maximum 24-hour lead concentration was 1.5. $\mu g/m^3$ at the downtown location (Table 6).

Sulphates (SO_4) at all Winnipeg stations are present in similar concentrations and all stations exhibit lower mean values than during 1983. The annual mean at station 9119 was 2.4 micrograms per cubic metre with a maximum 24-hour value of 15.3 $\mu g/m^3$. There are no Manitoba Air Quality Guidelines or Objectives for sulphates.

Nitrate (NO_3) concentrations at all Winnipeg stations are similar. The annual mean at station 9119 is 0.9 $\mu g/m^3$ and the maximum data value is 11.4 $\mu g/m^3$. There are no Manitoba Air Quality Guidelines or Objectives for Nitrates.

Based on the Canadian Air Quality Index, the air quality in downtown Winnipeg as measured at station 9119 is Fair, with a pollutant index value of 46 (Table 8). During 1983 the air quality was also Fair with a PI of 34. The main contributor to the Fair ratings during both years was 24-hour Total Suspended Particulate levels, all other pollutants fell into the Good range.

Residential: There are two stations located in residential areas in Winnipeg; Station 9118 (SO_2, CO, NO_2, O_3, COH, TSP, Pb, SO_4, NO_3) located at 299 Scotia Street and station 9120 (SO_2, CO, O_3, COH, TSP, Pb, SO_4, NO_3) located at 604 St. Mary's Road.

Sulphur Dioxide (SO_2) concentrations at the two residential sites (9118 and 9120) are similar to those downtown (9119) and are well below the Manitoba Air Quality Objectives for SO_2. At station 9118 the maximum SO_2 values were: 0.03 ppm for 1-hour and 0.02 for 24-hours and at station 9120 the maximum values were 0.30 (1-hour) and 0.02 (24-hours). There were no values greater than the MDL or MAL for SO_2 at either stations.

Carbon Monoxide (CO) levels at the two Winnipeg residential stations are lower than at the downtown station, 9119 (Table 3, Figures 7 and 8). Station 9120 had 15 excursions above the 8-hour Maximum Desirable Level of 5.0 parts per million while station 9118 which is located further from a major traffic artery had no values above any of the air quality objective levels.

The maximum CO concentrations recorded at station 9118 were 6.3 ppm (1-hour) and 3.0 ppm (8-hour) and at station 9120, 11.3 ppm (1-hour) and 6.2 ppm (8-hour).

Nitrogen Dioxide (NO_2) levels are not monitored at station 9120 but at station 9118, levels appear lower than at the downtown station. The maximum 1-hour data value was 6.1 pphm and the maximum 24-hour value was 2.8 pphm. there were no values approaching the Maximum Acceptable Levels of 21.3 pphm (1-hour) and 10.6 pphm (24-hour).

Ozone (O_3) levels at the St. Mary's Road station (9120) appear higher than at the Scotia Street location (9118), but this may be a function of data incompleteness at station 9118 where only 42.6 percent of the possible annual data was retrieved due to instrument problems. A portion of the missing data was from months normally having higher ozone concentrations.

The ozone air quality objective levels were frequently exceeded, especially the 24-hour Maximum Desirable and Maximum Acceptable Levels (Table 4). At station 9120, ozone levels appear comparable to those measured during 1983 except in 1984 there were fewer levels above the 1-hour Maximum Desirable Level. At station 9120 the maximum O_3 values were 12.0 pphm (1-hour) and 4.6 pphm (24-hour), at station 9118 the maximums were 13.0 pphm (1-hour) and 3.5 pphm (24-hour).

Soiling Index (COH) values at the two residential stations (9118, 9120) are similar to each other, and lower than at the downtown

station (9119). There were no levels above the MAQG's (24-hour) of 1.0 coefficient of haze units/100 feet of air (MAL) and 0.45 coefficient of haze units/1000 feet of air (MDL) at either station.

Station 9118 maximum values were 1.1 (2-hour) and 0.4 (24-hour) and station 9120 maximum were 1.1 (2-hour) and 0.3 (24-hour) coefficient of haze units per 1000 feet.

Fine particulate in the atmosphere as measured as soiling index (COH) appears to increase during the months of July, August and September at all three stations in Winnipeg (Table 5, Figures 17 and 18).

Total Suspended Particulate (TSP) levels at the residential stations are lower than at the downtown station (9119) but are higher than at the rural background station 4304 (Figures 20, 21 and 22, Table 5). Particulate levels at station 9120 are higher than those at station 9118 due to the proximity of station 9120 to St. Mary's Road a major traffic artery.

There were 5 values above the 24-hour MAL (120 $\mu g/m^3$) at station 9120 with a maximum recorded value of 186 $\mu g/m^3$ and 2 values greater than the MAL at station 9118 with a maximum value of 194 $\mu g/m^3$.

Lead (Pb) levels at stations 9118 and 9120 are lower than at the downtown station (9119) and well above the rural background station at St. Francois Xavier (4304).

Lead levels are well below the MAL of 5.0 $\mu g/m^3$, the maximum data value at station 9118 was 0.79 $\mu g/m^3$ and at station 9120 the maximum was 0.54 $\mu g/m^3$.

Sulphate (SO_4) and Nitrate (NO_3) concentrations at stations 9118 and 9120 are similar to concentrations at the other Winnipeg stations monitoring these parameters (Table 6, Figures 30, 31, 34 and 35).

The lack of variation in Sulphate and Nitrate levels from site to site when compared to the variability associated with other pollutants, suggests that these two parameters are "regional" as opposed to "local" pollutants, and may have an important long range transport component.

Winnipeg residential air quality as measured at station 9118 rates a Pollutant Index value of 31 or Fair whereas in 1983 it was 25 and Good. Station 9120 rates a PI of 32 and Fair, while in 1983 it was 27 and Fair. At both stations, as at the downtown station, Total Suspended Particulate levels were the most significant contributors to the Pollutant-Index followed by 1-hour ozone concentrations.

Industrial: Two of the major industrial monitoring stations were shut-down in January of 1984. Station 0793 (SO_2, H_2S) at 1011 Mission St. and station 0803 (SO_2) at the corner of Fournier St. and Panet Rd. were monitoring emissions from the St. Boniface Shell Oil Refinery which ceased its operations during September 1983.

The third station in an industrial area, station 9104 (TSP, Pb, SO_4, NO_3) at 800 Marion St. was shut-down in April 1984.

Sulphur Dioxide (SO_2) and Hydrogen Sulphide (H_2S) levels in the vicinity of the decommissioned oil refinery were typically below the detection level of the instruments (Tables 4 and 5).

Station 9104 is in an industrialized area of the city and near a major traffic route (Figure 2). Monitoring at this station was discontinued in April 1984, making comparisons with other stations difficult as the parameters monitored do show seasonal effects.

For the period of January to April 1984 the maximum Total Suspended Particulate (TSP) data value was 123 $\mu g/m^3$ and this was the only value that exceeded the Maximum Acceptable Level of 120 $\mu g/m^3$.

Lead (Pb) levels at station 9104 did not approach the Maximum Acceptable Level of 5.0 $\mu g/m^3$ for a 24-hour average. The maximum data value was 0.39 $\mu g/m^3$.

Sulphate (SO_4) and Nitrate (NO_3) mean concentrations measured at station 9104 appear higher than at the other Winnipeg stations, but this is due to the fact that monitoring only included those months that typically reported higher than normal levels as determined by the 1983 study period and other studies (Angelo et al., 1983).

Roadside: Air quality in the vicinity of areas with high density traffic is represented by data from station 2011 (TSP, Pb) 1350 Pembina Highway, and station 9102 (TSP, Pb, SO_4, NO_3) at 2120 Portage Avenue. Sampling at station 2011 was terminated in March, 1984.

Total Suspended Particulate (TSP) levels at stations 2011 and 9102 are similar and greater than the rural background station (4304) and the Scotia St. residential station (9118). They are however, lower than at the downtown station (9119). There was one value

recorded above the 24-hour MAL (120 $\mu g/m^3$) at station 2011, this maximum value was 138 $\mu g/m^3$. There were two values greater than the MAL at station 9102, and the maximum data value was 190 $\mu g/m^3$.

Lead (Pb) which is measured as a constituent of TSP follows a similar pattern as the TSP results at stations 2011 and 9102. The two roadside stations have similar Pb levels, which are greater than levels at the rural station (4304) and the Scotia St. residential station (9118), but lower than at the downtown station (9119). All 24-hour Pb values were well below the Maximum Acceptable Level of 5.0 $\mu g/m^3$. The maximum at station 2011 was 0.41 $\mu g/m^3$ and at station 9102 it was 1.11 $\mu g/m^3$.

Sulphates (SO_4) and Nitrates (NO_3) were not monitored at station 2011, but at station 9102 levels measured were similar to those at the other Winnipeg stations monitoring these pollutants (Table 6).

Background: Background levels of TSP and Pb are monitored at station 4304 (St. Francois Xavier) approximately 7 kilometres west of Winnipeg's city limits. Background levels of both parameters are considerably lower than levels monitored within the city (Tables 5 and 6) due to reduced traffic densities and the absence of industry.

Dustfall: Dustfall in the Winnipeg air basin (5 sites) as collected by sedimentation into dustfall canisters, is summarized in Table 7 and Figure 37. Results are expressed in units of tons per square mile per 30 days above levels measured at a background station in rural Manitoba (Morden).

Results are only available from January to April 1984 as the program was discontinued.

There were 2 monthly averages above the MDL (17.1 tons/sq. mi./30 days) and 1 monthly average above the MAL (22.8 tons/sq. mi./30 days) in the Winnipeg air basin.

Sulphation: Sulphation in the Winnipeg air basin (5 sites) from January to April 1984 was barely detectable and slightly above levels found at the rural background station in Morden (Table 7). There were no values greater than either of the Guideline levels.

Brandon Air Quality

Downtown: Air quality in downtown Brandon is represented by data from station 9201 (TSP, Pb, SO_4, NO_3) located at 1104 Princess Avenue (Figure 3).

Total Suspended Particulate (TSP) levels at station 9201 are higher than levels at the Brandon industrial station (5131), higher than at the rural background station (4304), lower than the downtown Winnipeg station (9119) and similar to levels recorded at Winnipeg stations 9102 and 9120. There were 3 sampling periods with TSP levels greater than the 24-hour MAL (120 $\mu g/m^3$) at the downtown Brandon station and the maximum data value was 161 $\mu g/m^3$.

Lead (Pb) levels at station 9201 are higher than levels at the Brandon industrial station (5131), higher than at the rural background station (4304), lower than the downtown Winnipeg station

(9119) and similar to levels at the Winnipeg residential stations (9118, 9120). No values exceeded the Manitoba Air Quality Guideline for lead and the maximum Pb value recorded at station 9201 was 0.41 $\mu g/m^3$.

Sulphate (SO_4) and Nitrate (NO_3) levels at station 9201 appear lower than at the Brandon industrial site (5131) but again this is probably a function of data incompleteness as monitoring for these parameters was discontinued at station 5131 in March, 1984. Past studies have shown the highest levels of SO_4 and NO_3 occurring during the winter.

Sulphate (SO_4) levels at station 9201 appear lower than at the Winnipeg stations and Nitrate (NO_3) levels are similar to levels measured at the Winnipeg stations.

Industrial: Air quality in an industrial area of Brandon is represented by data from station 5131 (SO_2, NO_2, NO, O_3, NH_3, TSP, Pb, SO_4, NO_3) situated on the grounds of the Assiniboine Community College in the east end of Brandon (Figure 3).

Sulphur Dioxide (SO_2) levels at station 5131 as during 1983 are mostly undetectable and similar to other non-source specific stations in Winnipeg (9118, 9119, 9120). Monitoring for SO_2 at 5131 was discontinued in June, 1984. No hourly averages exceeded the SO_2 air quality objective levels and the maximum data values were 5.8 pphm (1-hour) and 0.4 pphm (24-hour).

Nitrogen Dioxide (NO_2) levels at station 5131 during 1984 are similar to the 1983 data and are lower than levels found at the Winnipeg stations (9118, 9120). No values exceeded the MAQO Maximum

Acceptable Levels of 0.213 ppm (1-hour) and 0.106 ppm (24-hour). The maximum data values at station 5131 were 0.184 pphm (1-hour) and 0.025 pphm (24-hour).

Nitric Oxide (NO) concentrations were also monitored at station 5131 although there are no Manitoba Air Quality Guidelines or Objectives for this pollutant. The annual mean was 0.4 pphm with maximum values of 53.6 pphm (1-hour) and 7.3 pphm (24-hour).

Ozone (O_3) levels at station 5131 are higher than those found at the three stations in Winnipeg monitoring O_3. There were numerous values exceeding the 1-hour and the 24-hour MDL and MAL's (Table 4), especially during the summer months when increased photo-period resulted in elevated O_3 levels. The maximum data values at station 5131 were 12.2 pphm (1-hour) and 5.1 pphm (24-hour).

Ammonia (NH_3) monitoring at station 5131 is emission-source specific as the NH_3 monitor is located in the vicinity of a chemical company which produces and uses ammonia in the production of fertilizer.

The guideline promulgated by the Province of Manitoba for Ammonia is 2 ppm as a time weighted average for any one hour period (Maximum Acceptable Level). This level was exceeded 71 times during 1984 compared to 85 times during 1983. In July, 1984 the Manitoba Government's Clean Environment Commission limit of 3 ppm was put into effect. This level was exceeded 11 times from the effective date (July 1, 1984) to the end of 1984.

The annual mean was 0.1 ppm and the maximum 1-hour data value was 5.9 ppm (Table 4). There continues to be a strong correlation between winds from the general direction of the chemical company and ammonia incidents (Regehr, 1985).

Total Suspended Particulates (TSP), Lead (Pb), Sulphates (SO_4) and Nitrates (NO_3) ceased being monitored at station 5131 in March, 1984. This lack of data involving parameters with marked seasonal variations makes comparison with other stations unreliable. The TSP, Pb, SO_4 and NO_3 data statistics for January, February and March, 1984 are contained in Tables 5 and 6.

The Pas Air Quality

Hydrogen Sulphide (H_2S) is the only air quality parameter measured in The Pas. The H_2S monitor is located in The Pas Provincial Building at the intersection of 3rd Street and Ross Avenue (Figure 4) and the primary H_2S source is a pulp and paper manufacturer located northeast of town. Hydrogen Sulphide levels recorded at The Pas monitor are normally undetectable (minimum detectable: 3 ppb) but there were 6 one-hour average values greater than the MAL (11 ppb) and 10 twenty-four hour averages greater than the 24-hour MAL (4 ppb) during 1984. These numbers could have been greater but there was only 57% data recovery due to instrument breakdowns.

The maximum data values were 19 ppb (1-hour) and 5 ppb (24-hours).

Flin Flon Air Quality

The only air pollutant monitored in the Flin Flon area is Sulphur Dioxide (SO_2) at two sites in the FLin Flon area; station

7211 at 55 Main Street (moved to 35 Main Street in August, 1984 and assigned new station number 7233) and station 7222 located at Channing Drive near the outskirts of town (Figure 5). The primary source of SO_2 in Flin Flon is a mining and smelting company located in downtown Flin Flon.

Sulphur Dioxide levels measured at the downtown station (7211, 7233) appear higher than at the more remote Channing Drive location (7222). There were 52, 1-hour averages greater than the 1-hour Maximum Desirable Level (0.17 ppm) and 69, 24-hour averages greater than the 24-hour MDL (0.06 ppm) recorded by the downtown monitor, compared to 32 (1-hour MDL) and 15 (24-hour MDL) at the Channing Station (Table 5).

A similar trend occurred during 1983 and may indicate that non-stack sources such as ventilation and fugitive emissions are contributing to affect ambient SO_2 levels within the immediate vicinity of the smelter (Regehr, 1983).

The 1984 SO_2 levels as monitored at the two Flin Flon stations appear lower than during 1983, with fewer excursions above the Objective levels occurring. The maximum data values downtown were 0.61 ppm (1-hour) and 0.14 ppm (24-hour) and at Channing the maximum values were 0.64 ppm (1-hour) and 0.07 ppm (24-hours).

Thompson Air Quality

Sulphur Dioxide (SO_2) is the only pollutant monitored in Thompson, at station 7344 in the Thompson Provincial Building (Figure 6). The primary source of SO_2 in Thompson is a mining and smelting

company located in the south end of town. Sulphur Dioxide (SO_2) objective levels were exceeded with more frequency at the Thompson station than at the two Flin Flon stations combined (Table 5). There were 19, one-hour averages greater than the 1-hour MAL (0.34 ppm) and 37, 24-hour averages greater than the 24-hour MAL (0.11 ppm) at station 7344. There were a similar number of excursions above the objective levels during 1983 but these were achieved during a sampling period (1983) that had ten percent less data availability due to instrument problems. The maximum data values were 0.69 ppm (1-hour) and 0.18 ppm (24-hours).

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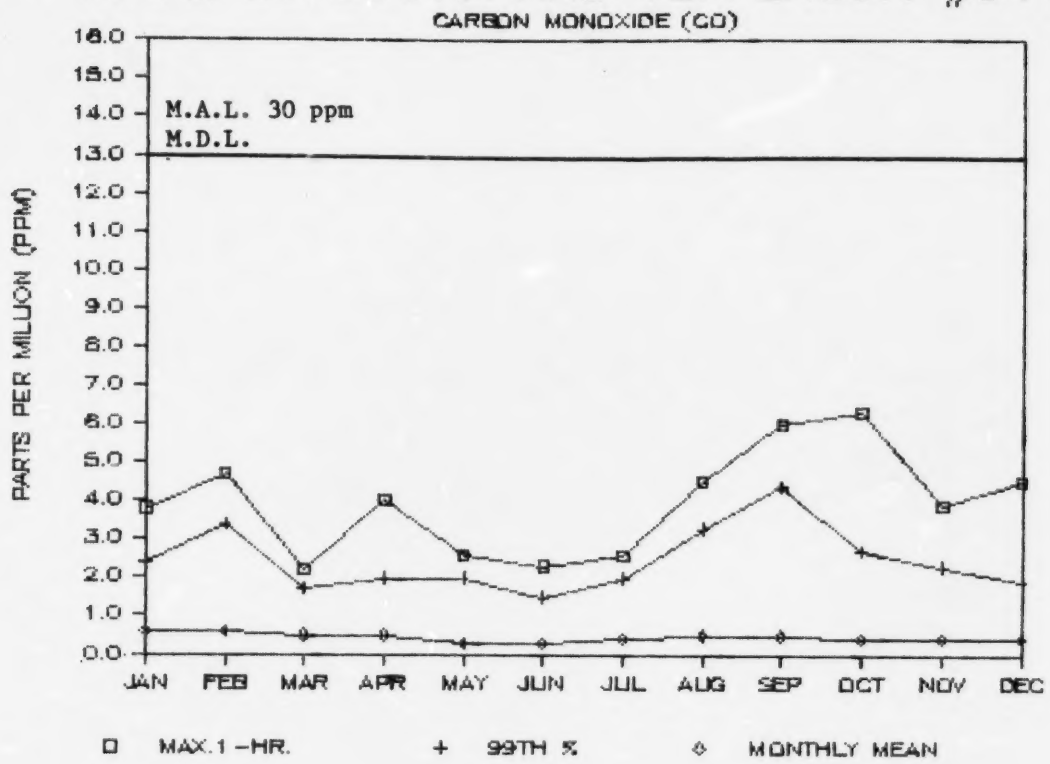
APPENDIX

FIG. 7 WINNIPEG SCOTIA AND JEFFERSON #9118



WINNIPEG 65 ELLEN ST. #9119

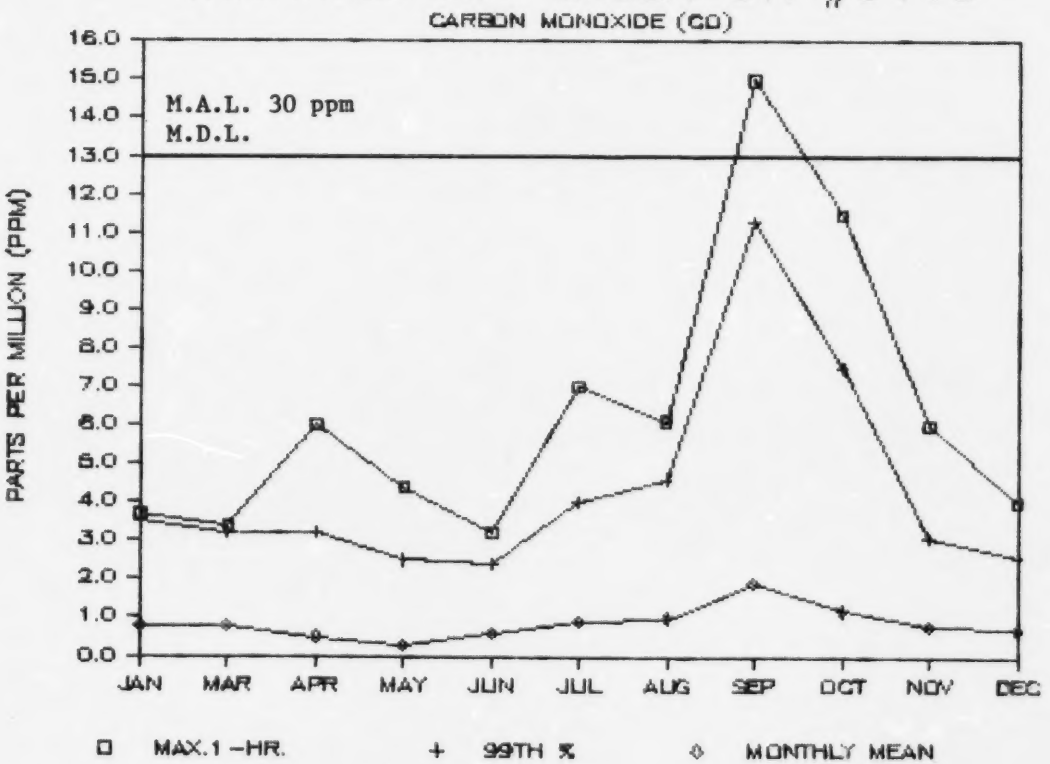


FIG. 8

WINNIPEG 604 ST. MARYS RD. #9120

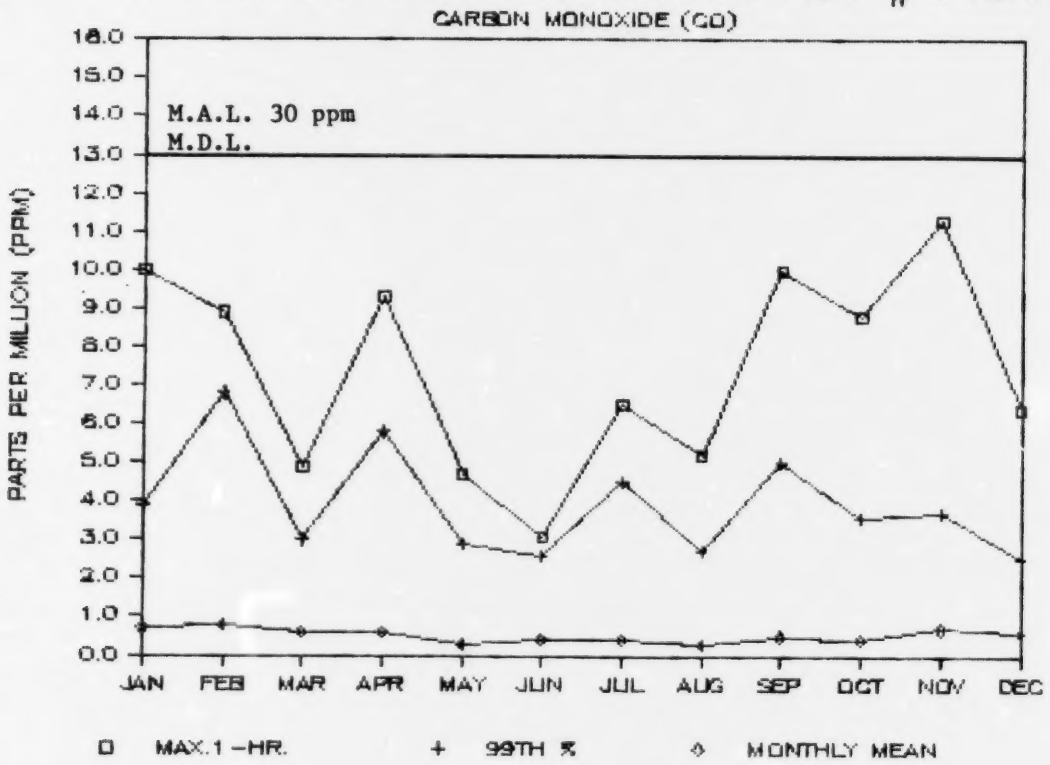
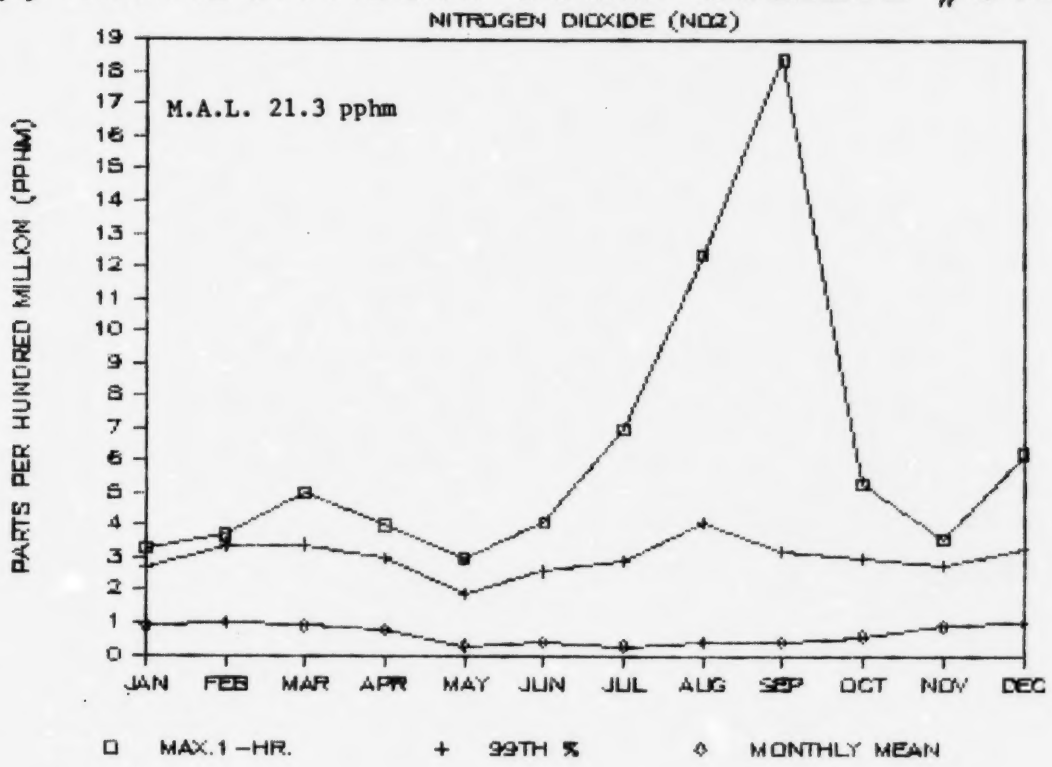


FIG. 9

BRANDON ASSIN. COMM. COLLEGE #5131


NITROGEN DIOXIDE (NO2)
M.A.L. 21.3 pphm
PARTS PER HUNDRED MILLION (PPHM)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
□ MAX.1-HR. + 99TH % ◇ MONTHLY MEAN

WINNIPEG SCOTIA AND JEFFERSON #9118

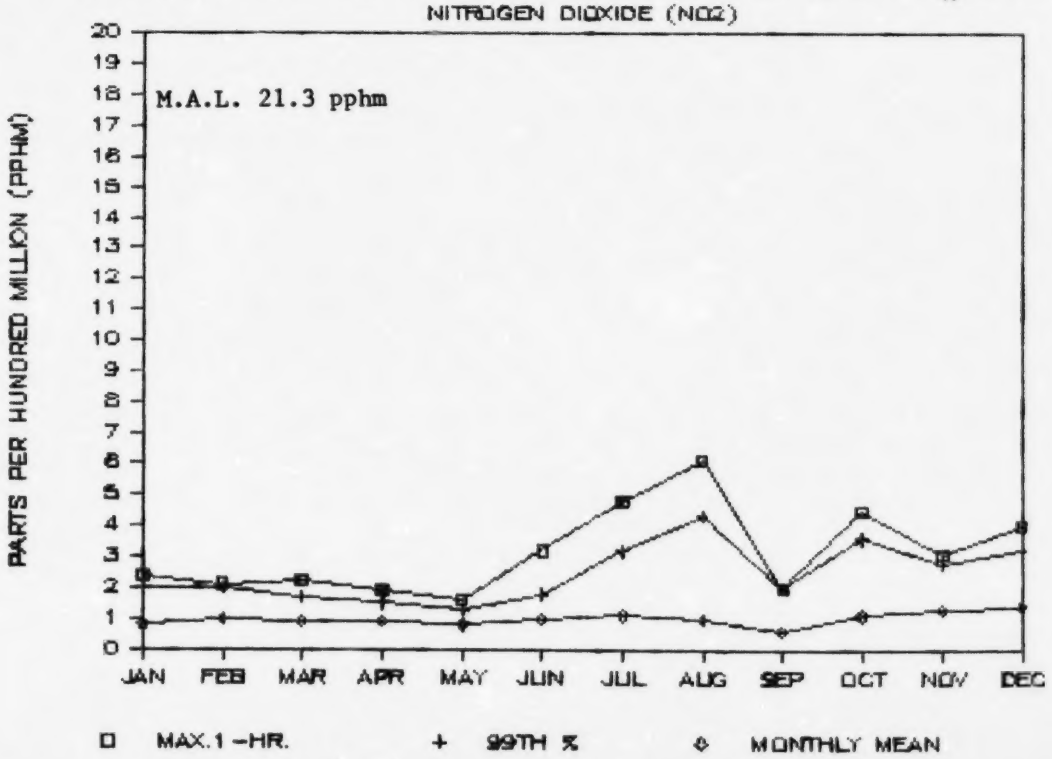

NITROGEN DIOXIDE (NO2)
M.A.L. 21.3 pphm
PARTS PER HUNDRED MILLION (PPHM)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
□ MAX.1-HR. + 99TH % ◇ MONTHLY MEAN

FIG. 10

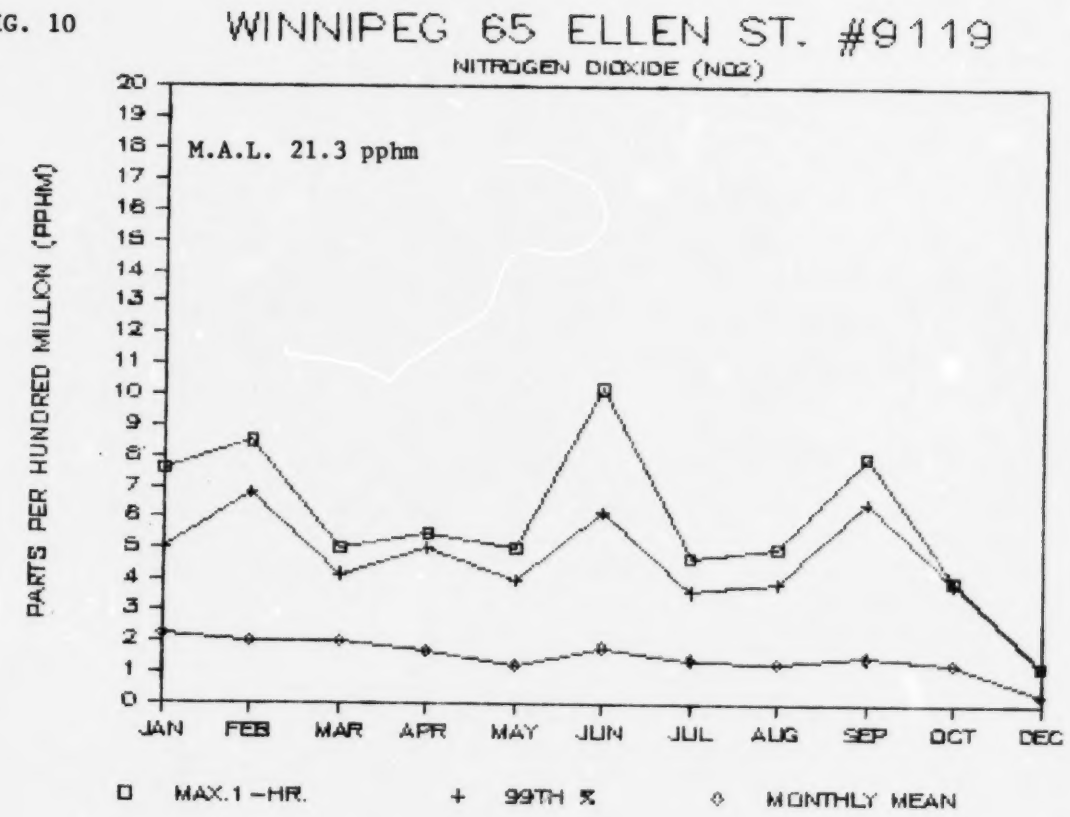
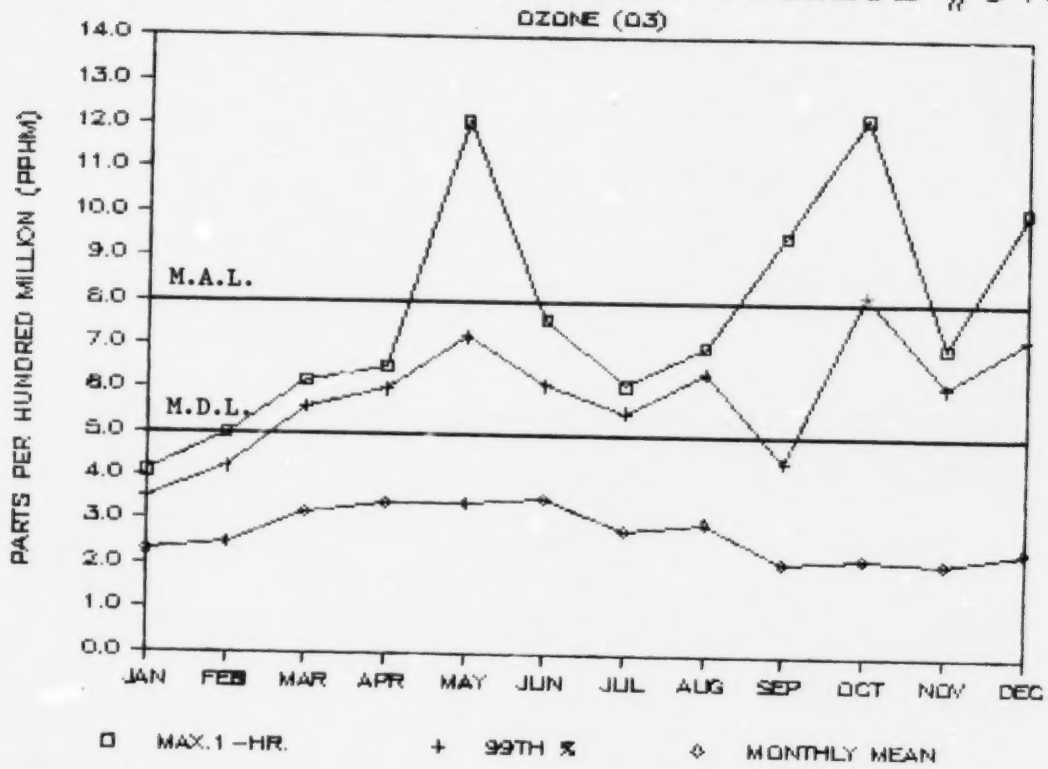

WINNIPEG 65 ELLEN ST. #9119
NITROGEN DIOXIDE (NO2)
M.A.L. 21.3 pphm
PARTS PER HUNDRED MILLION (PPHM)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
DEC
MAX.1-HR.
99TH %
MONTHLY MEAN

FIG. 11 BRANDON ASSIN. COMM. COLLEGE #5131



WINNIPEG SCOTIA AND JEFFERSON #9118

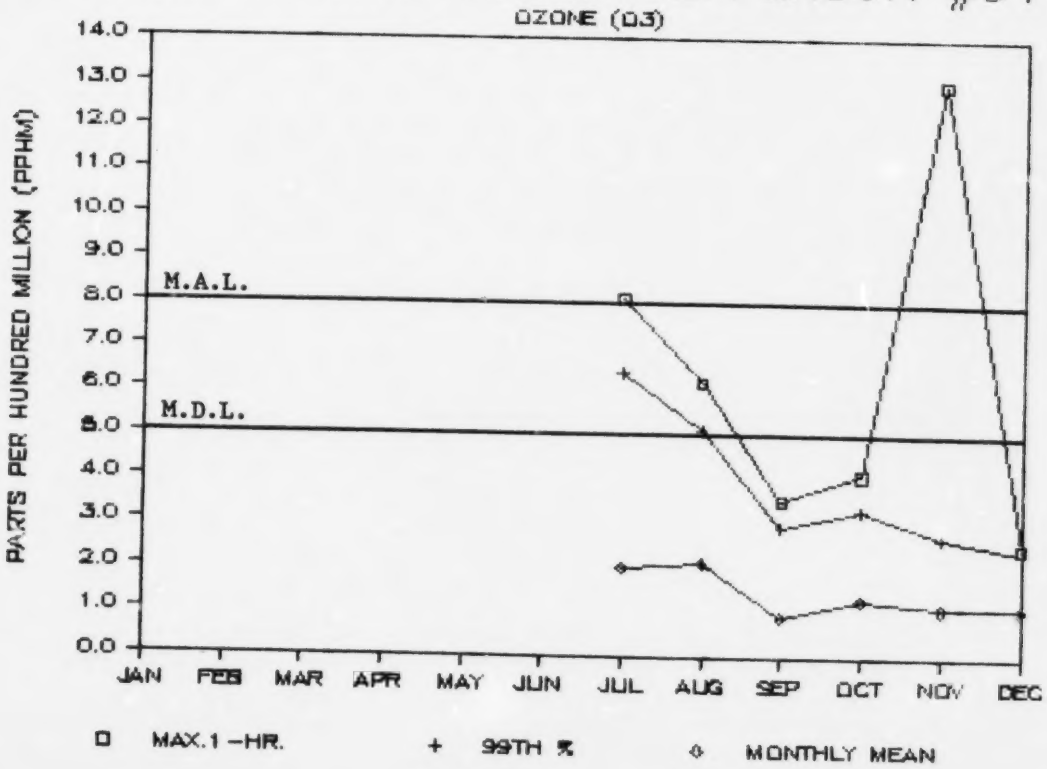
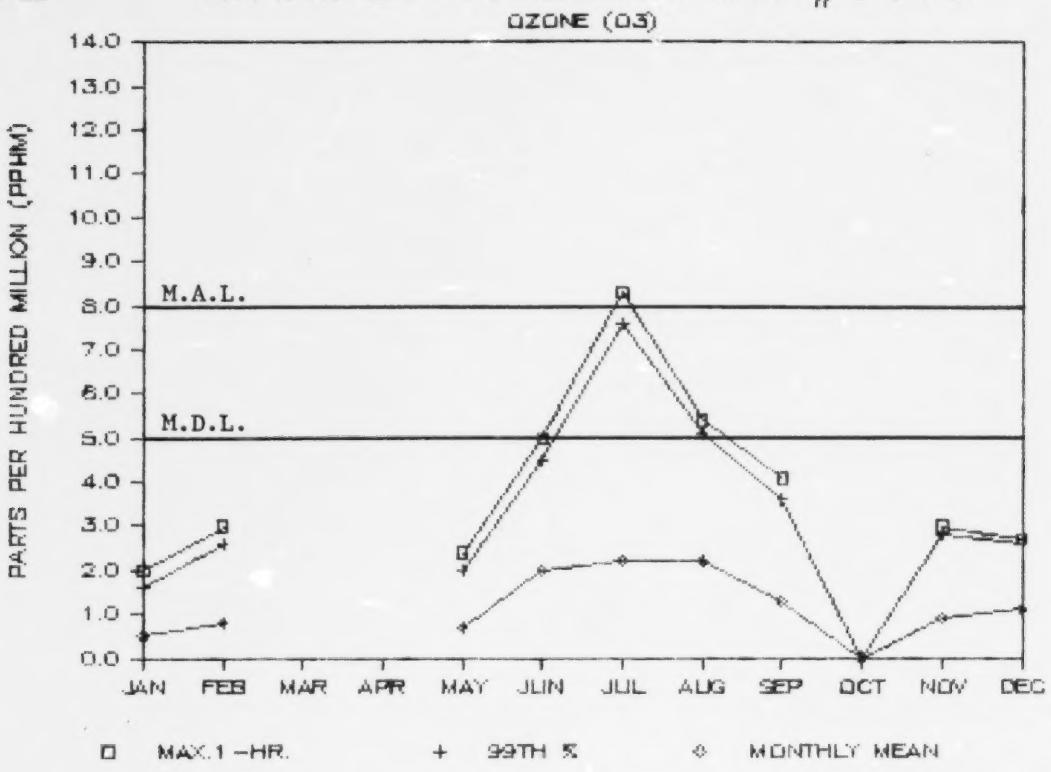


FIG. 12

WINNIPEG 65 ELLEN ST. #9119



WINNIPEG 604 ST. MARYS RD. #9120

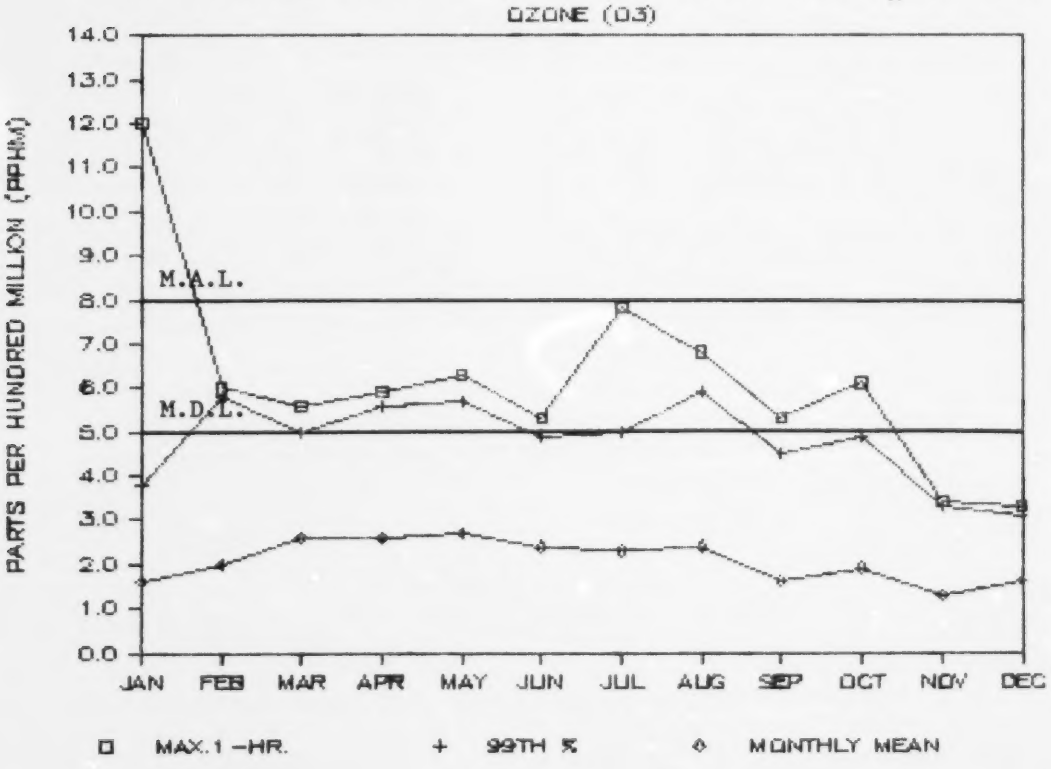


FIG. 13 BRANDON ASSIN. COMM. COLLEGE #5131

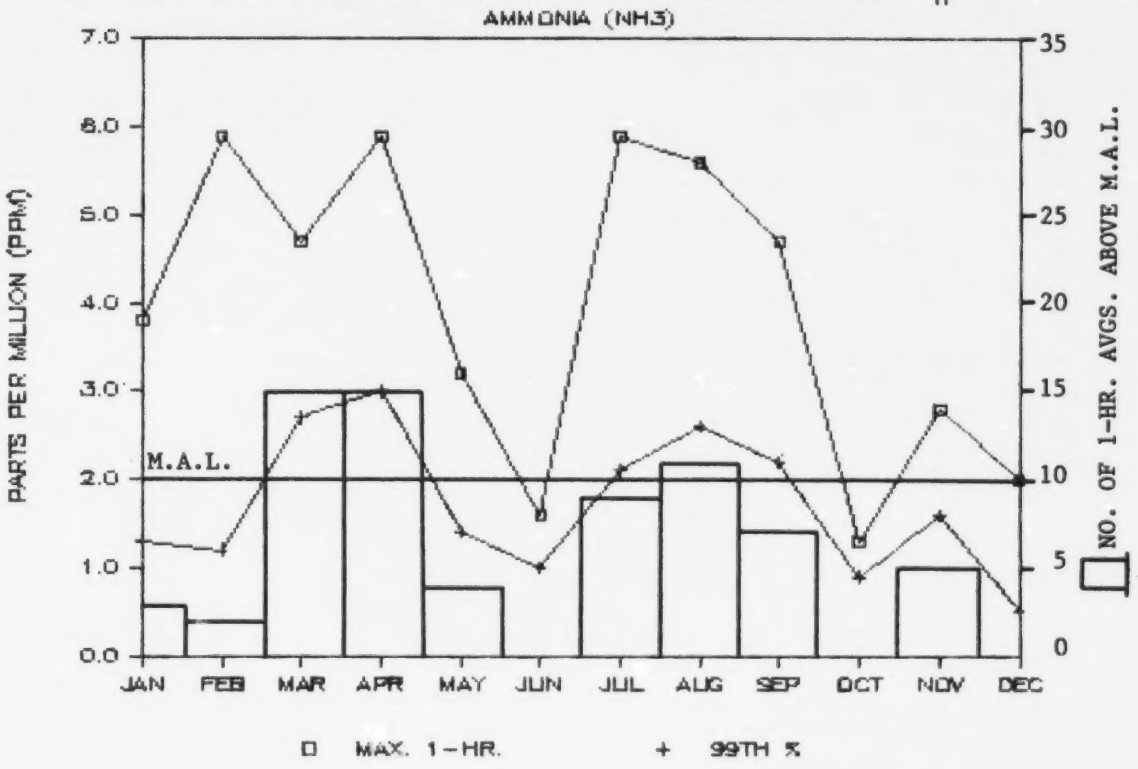


FIG. 14

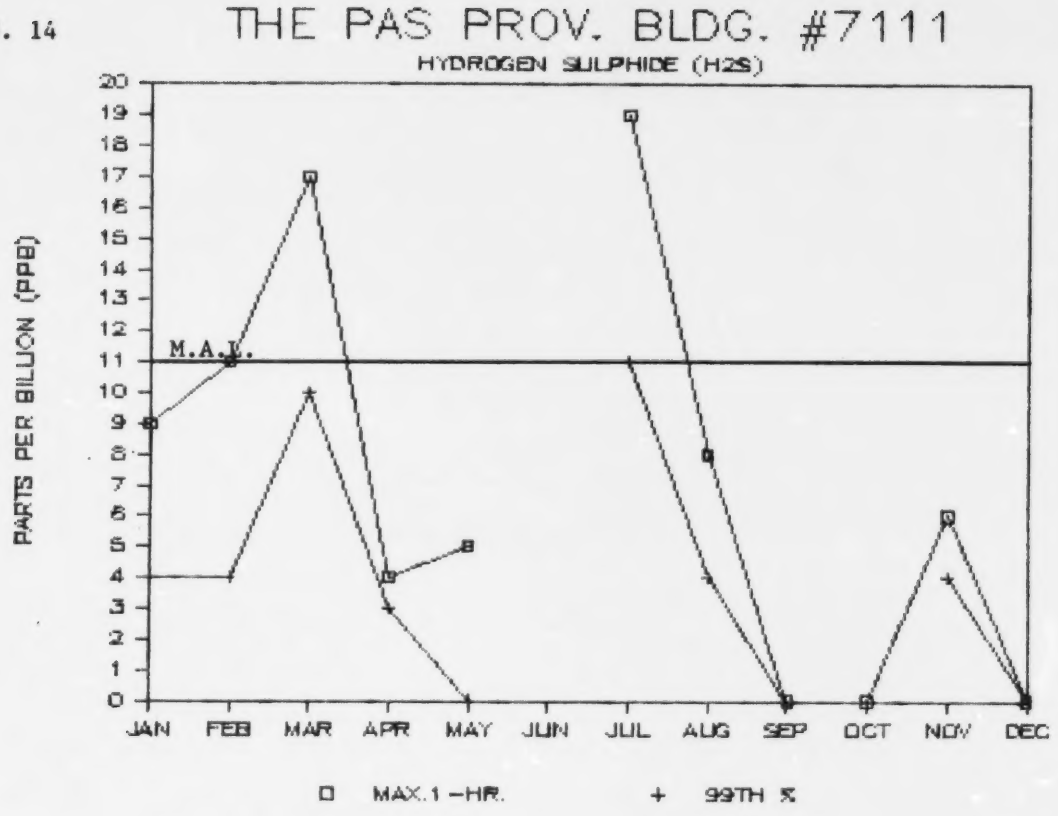
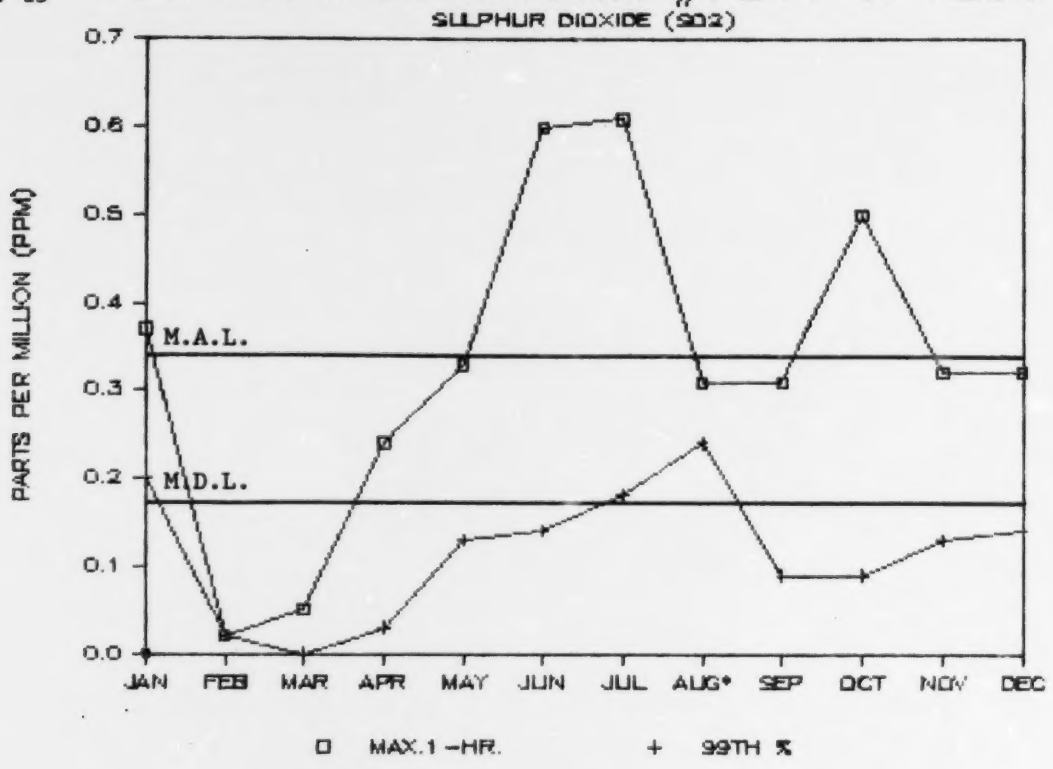

THE PAS PROV. BLDG. #7111
HYDROGEN SULPHIDE (H2S)
PARTS PER BILLION (PPB)
M.A.I.L.
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MAX.1-HR.
99TH %

FIG. 15

FLIN FLON DOWNTOWN #7211 & 7233*



FLIN FLON CHANNING #7222

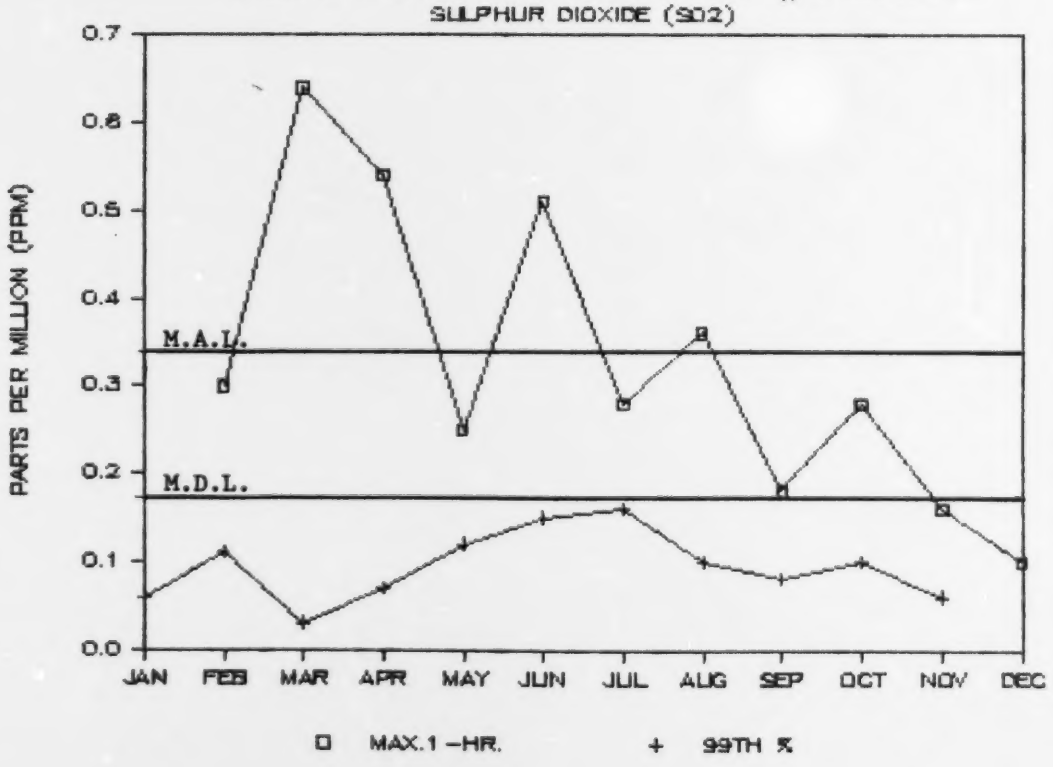


FIG. 16

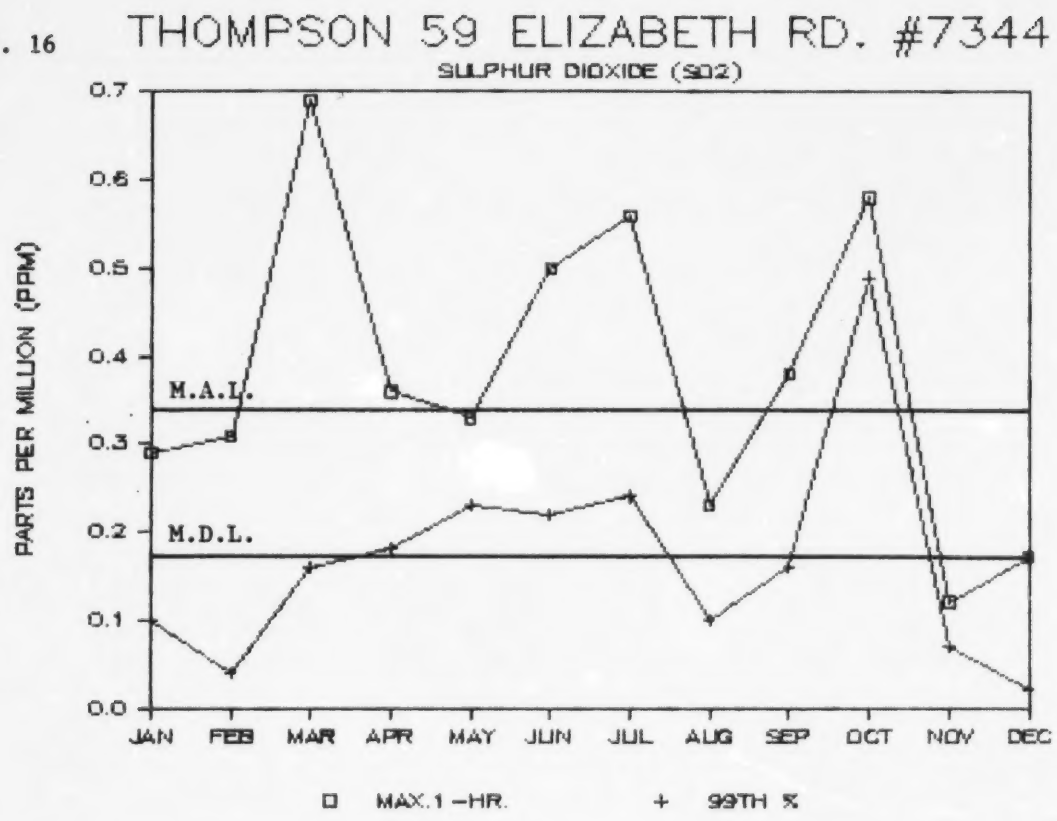
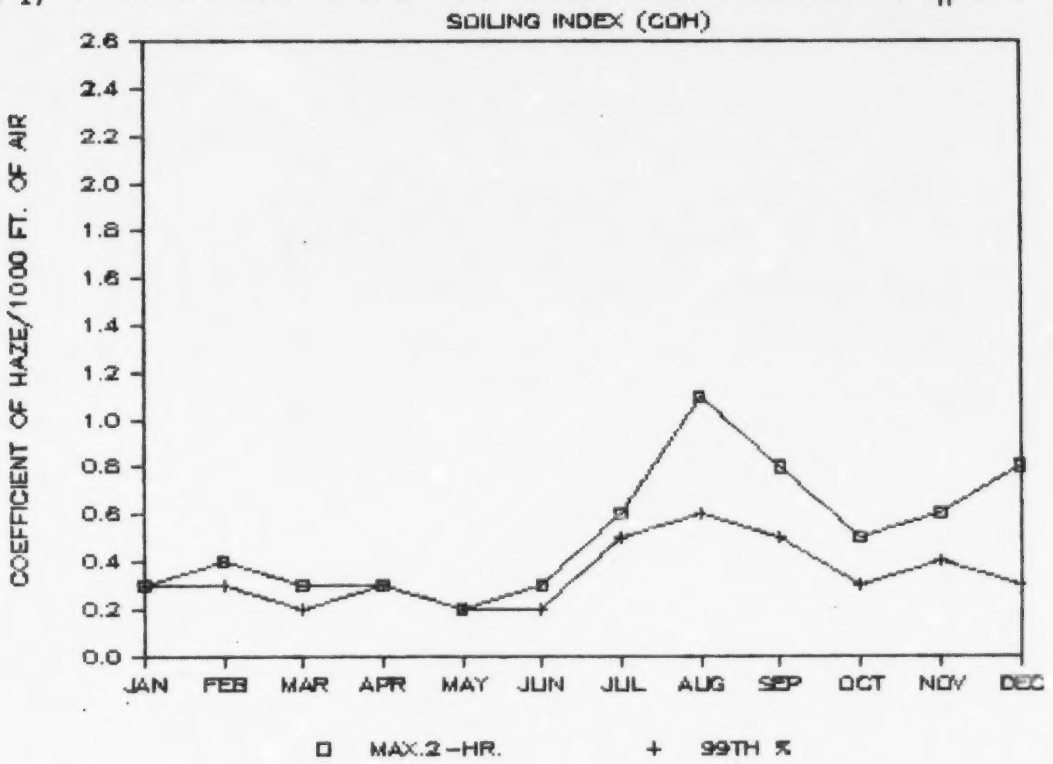

THOMPSON 59 ELIZABETH RD. #7344
SULPHUR DIOXIDE (SO2)
PARTS PER MILLION (PPM)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
M.A.L.
M.D.L.
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MAX.1-HR.
99TH %

FIG. 17 WINNIPEG SCOTIA AND JEFFERSON #9118



WINNIPEG 65 ELLEN ST. #9119

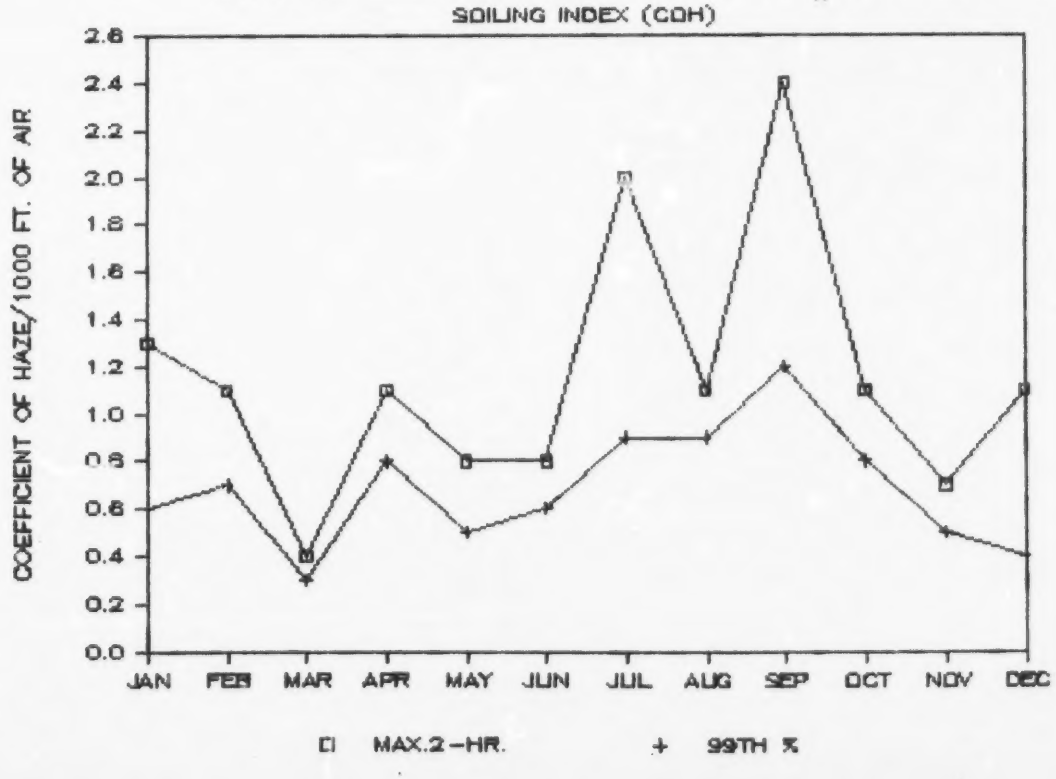


FIG. 18

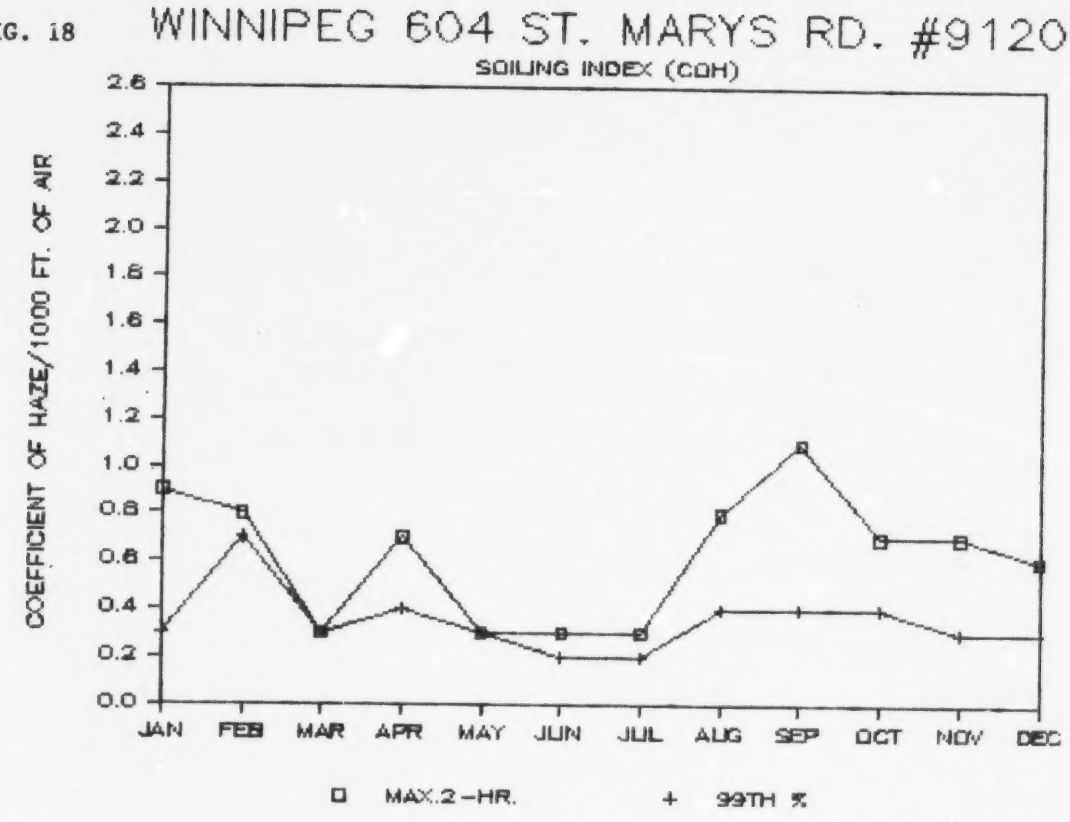
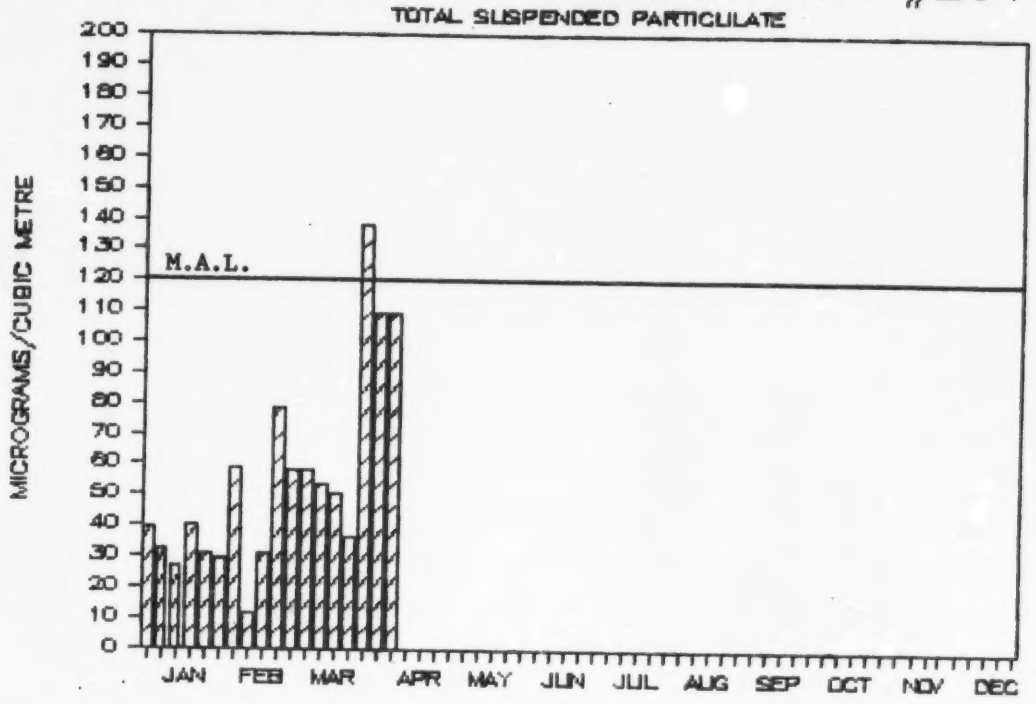

WINNIPEG 604 ST. MARYS RD. #9120
SOILING INDEX (COH)
COEFFICIENT OF HAZE/1000 FT. OF AIR
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
MAX.2-HR.
99TH %

FIG. 19

WINNIPEG 1350 PEMBINA HWY. #2011



WINNIPEG 2109 PORTAGE AVE. #9102

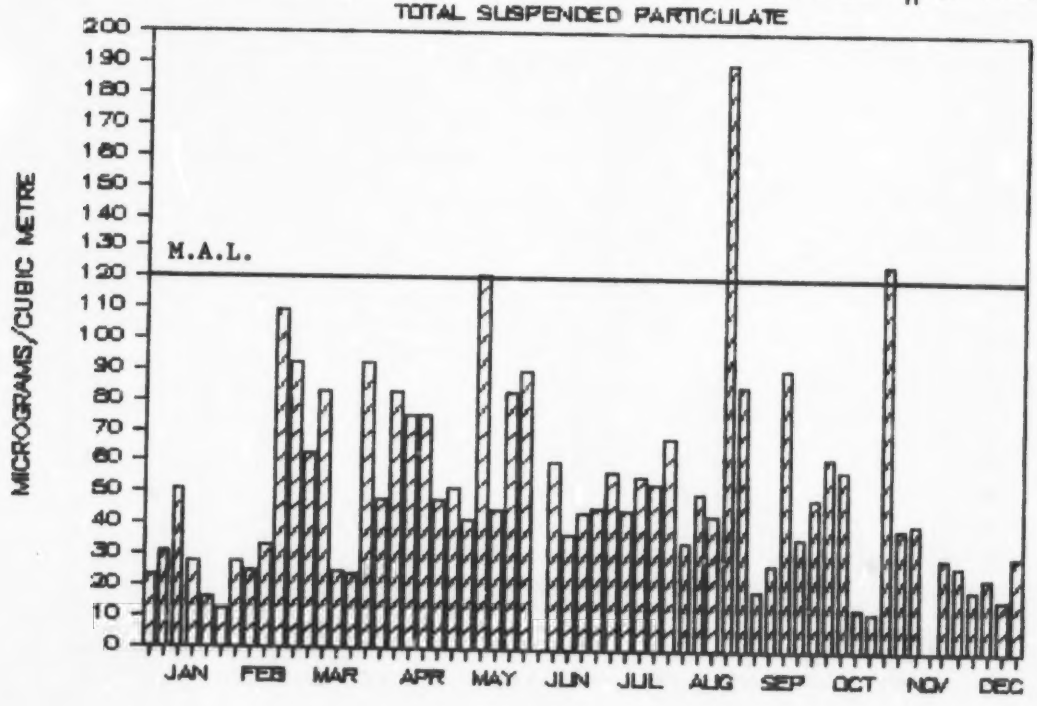
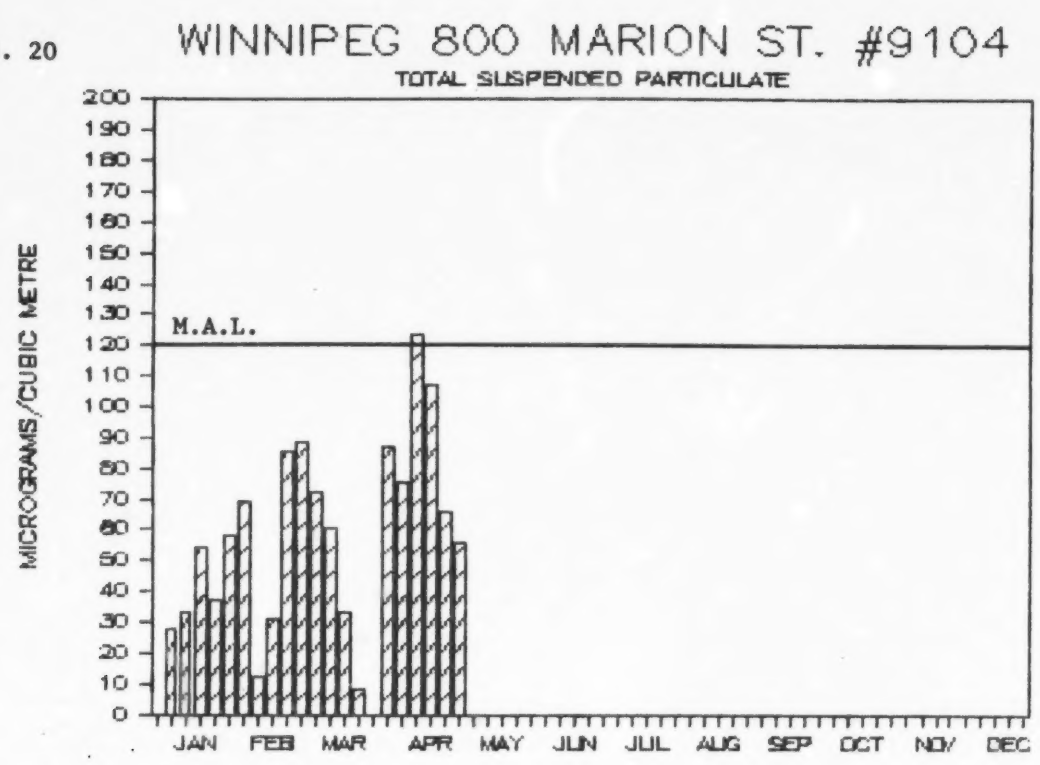


FIG. 20


WINNIPEG 800 MARION ST. #9104
TOTAL SUSPENDED PARTICULATE
MICROGRAMS/CUBIC METRE
M.A.L.
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

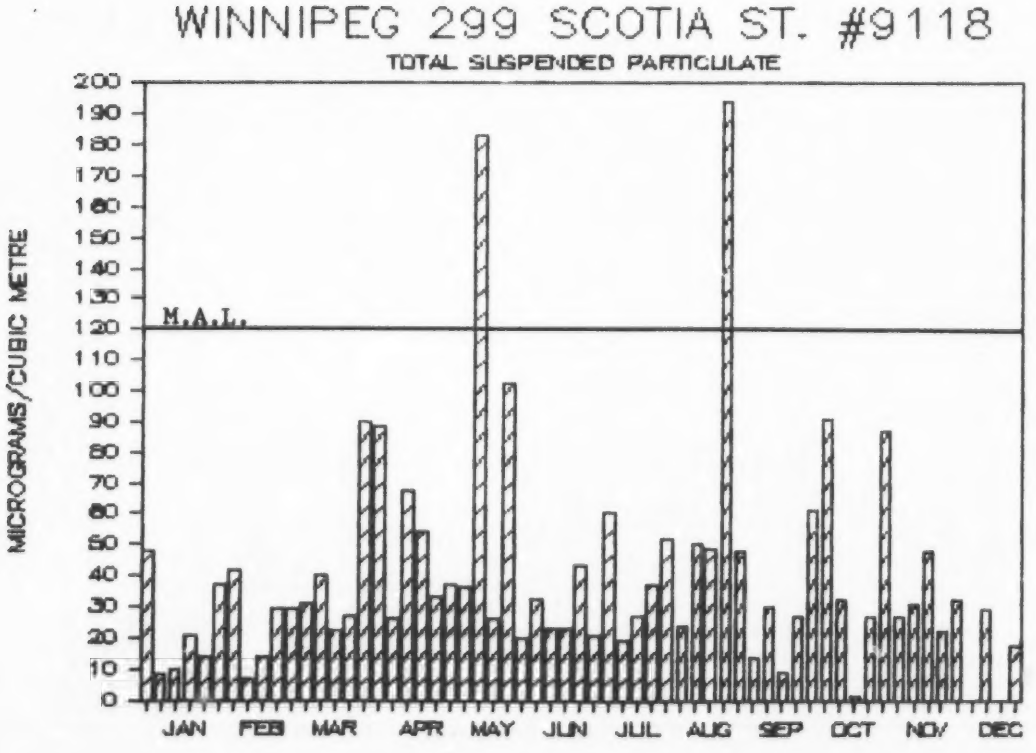
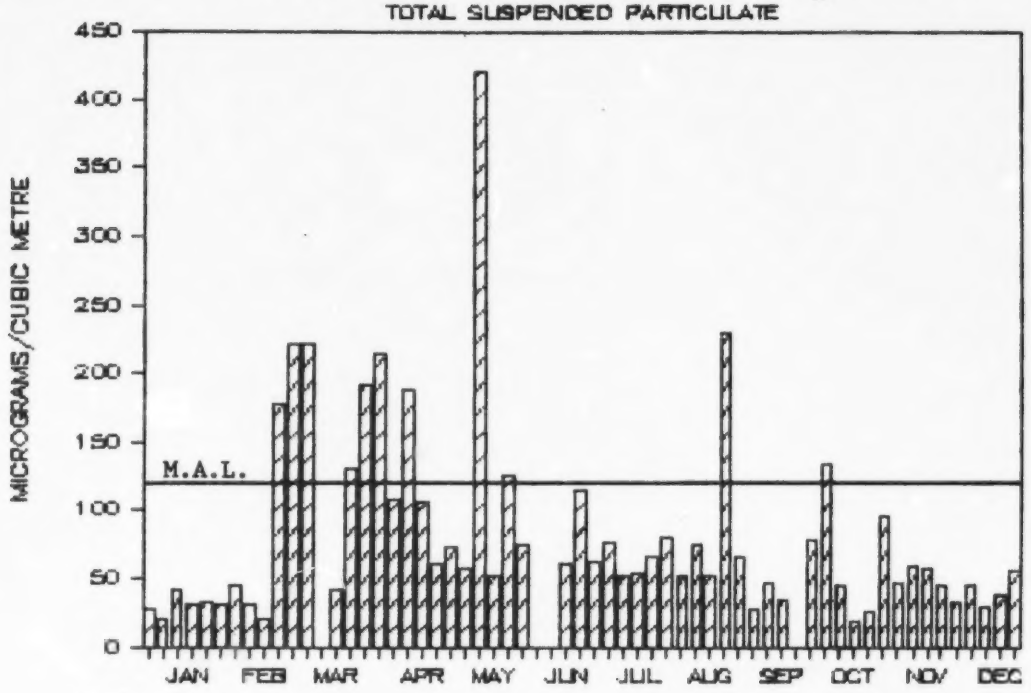

WINNIPEG 299 SCOTIA ST. #9118
TOTAL SUSPENDED PARTICULATE
MICROGRAMS/CUBIC METRE
M.A.L.
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIG. 21

WINNIPEG 65 ELLEN ST. #9119

TOTAL SUSPENDED PARTICULATE



WINNIPEG 604 ST. MARYS RD. #9120

TOTAL SUSPENDED PARTICULATE

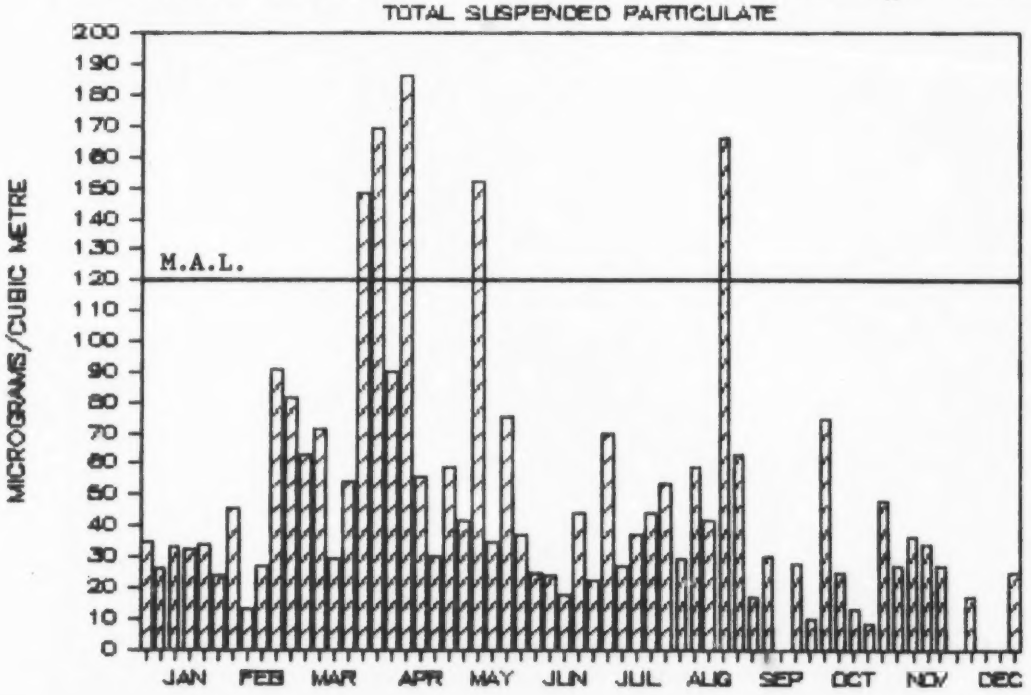
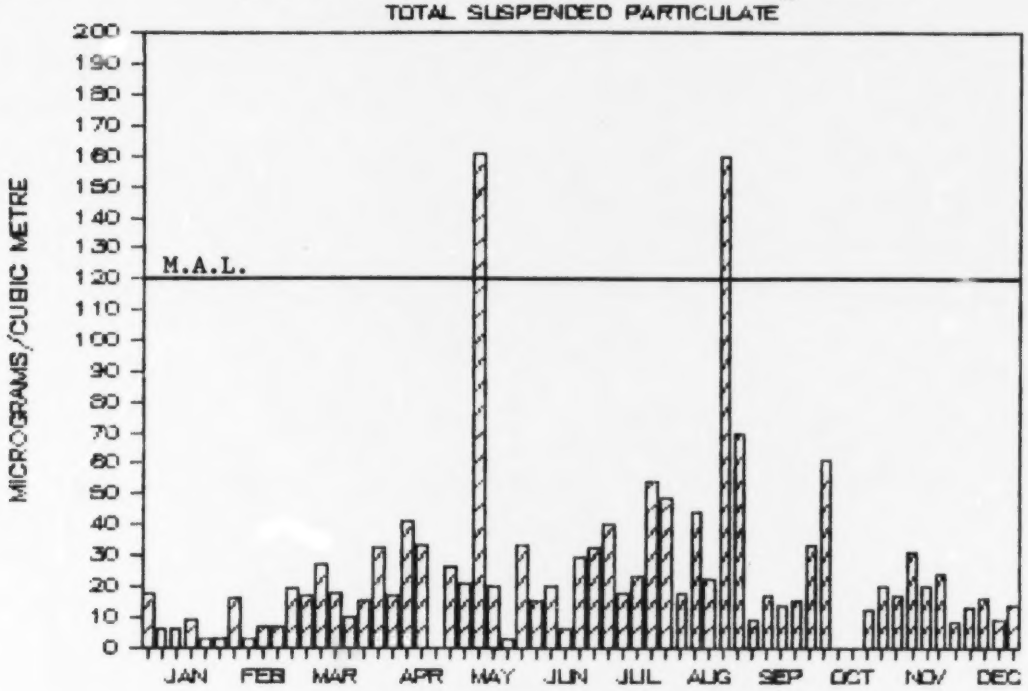


FIG. 22

ST. FRANCOIS XAVIER #4304

TOTAL SUSPENDED PARTICULATE



BRANDON ASSIN. COMM. COLLEGE #5131

TOTAL SUSPENDED PARTICULATE

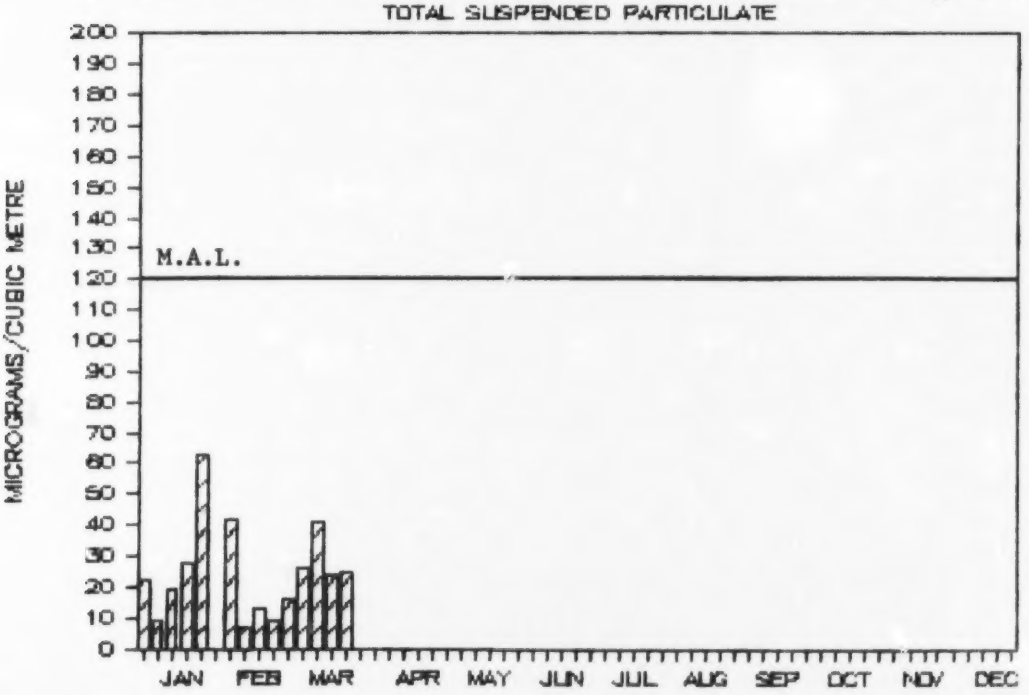


FIG. 23

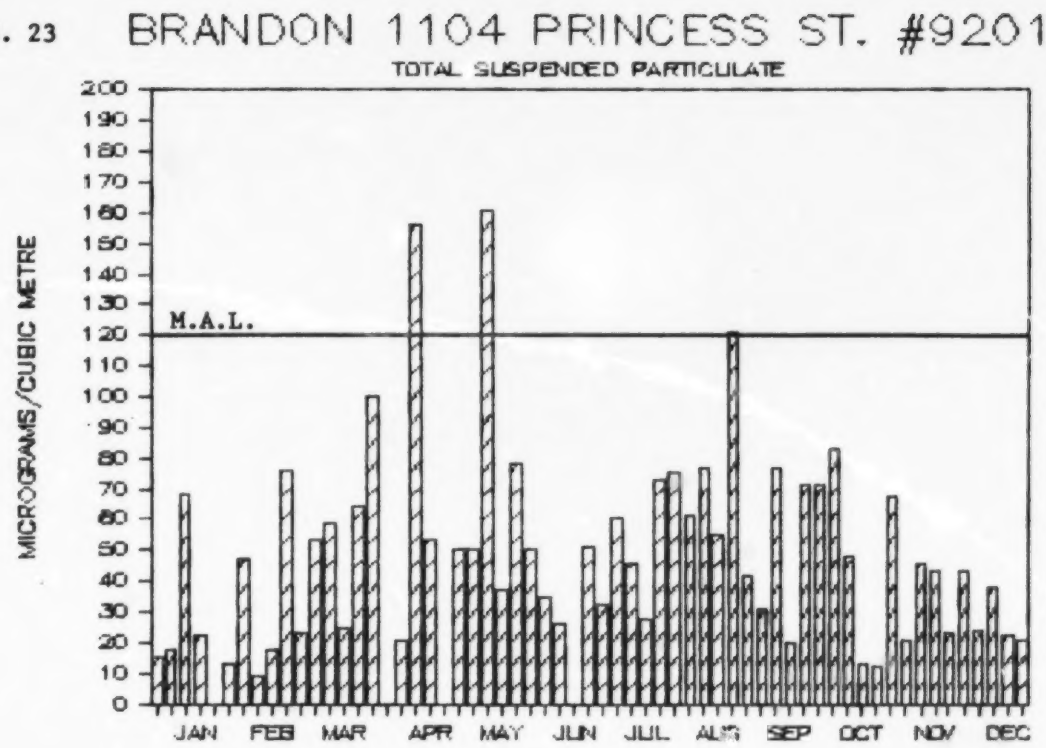
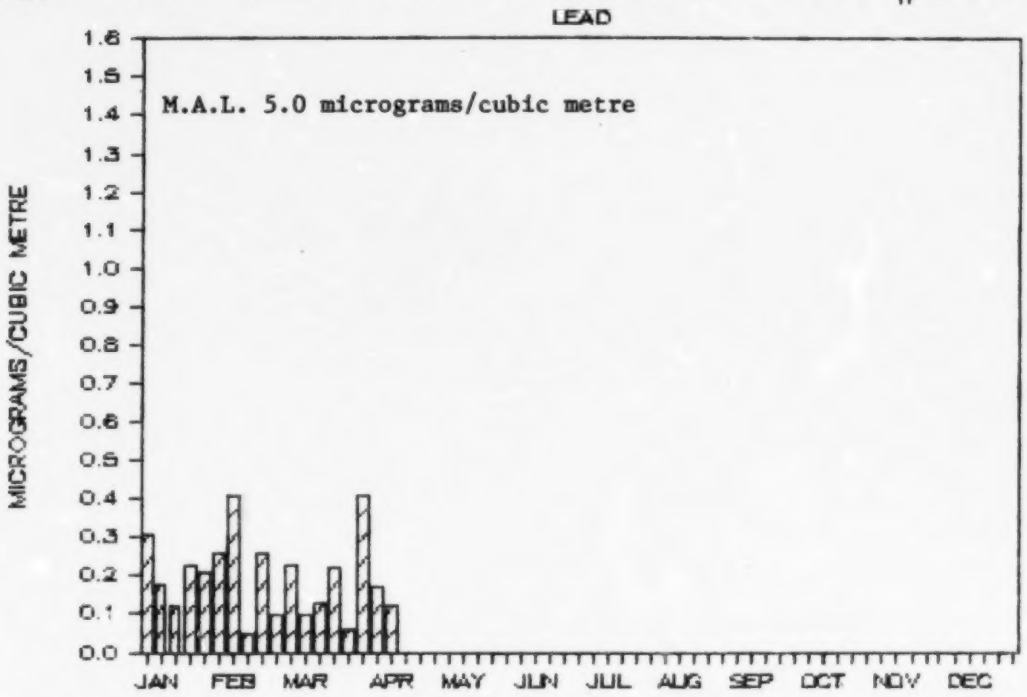

BRANDON 1104 PRINCESS ST. #9201
TOTAL SUSPENDED PARTICULATE
MICROGRAMS/CUBIC METRE
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
M.A.L.
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIG. 24

WINNIPEG 1350 PEMBINA HWY. #2011



WINNIPEG 2109 PORTAGE AVE. #9102

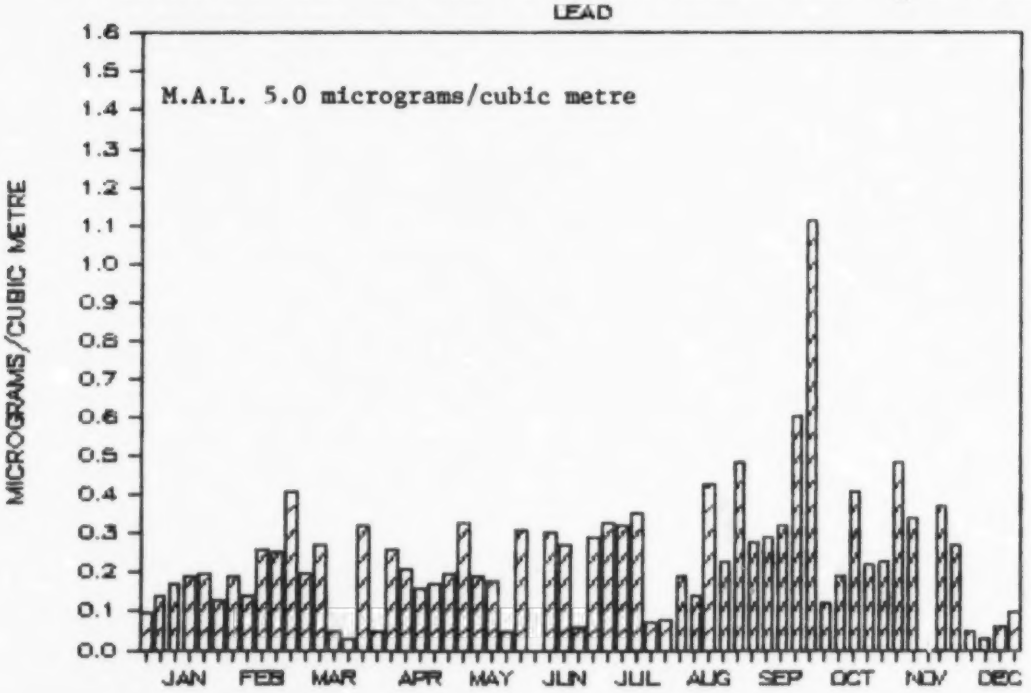
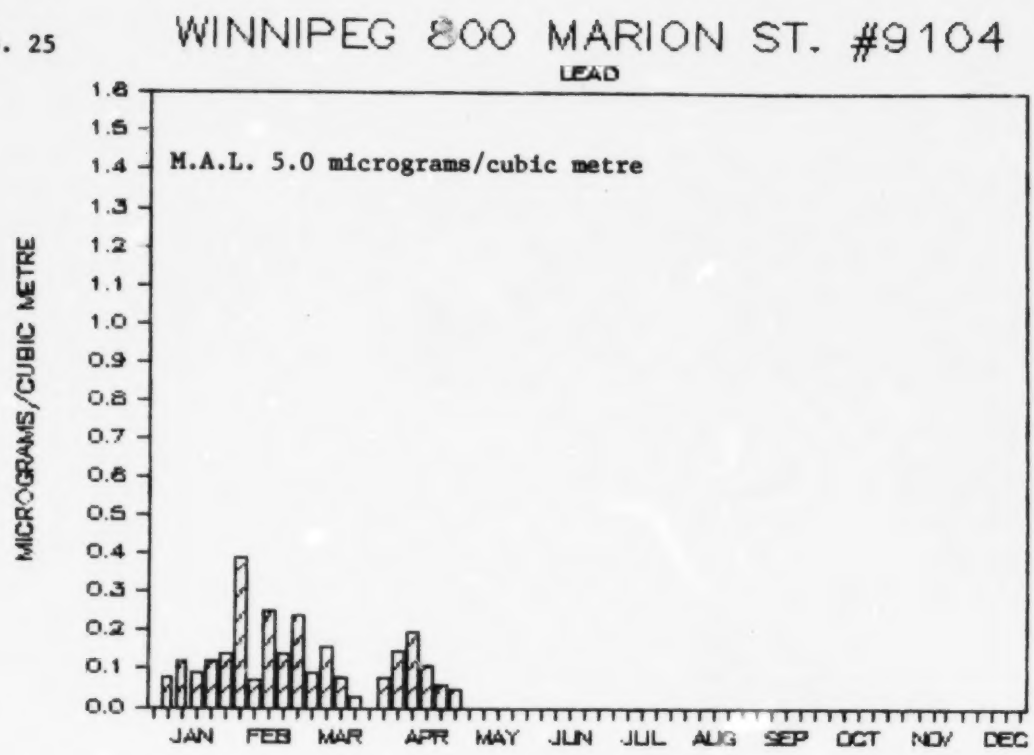


FIG. 25


WINNIPEG 800 MARION ST. #9104
LEAD
M.A.L. 5.0 micrograms/cubic metre
MICROGRAMS/CUBIC METRE
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

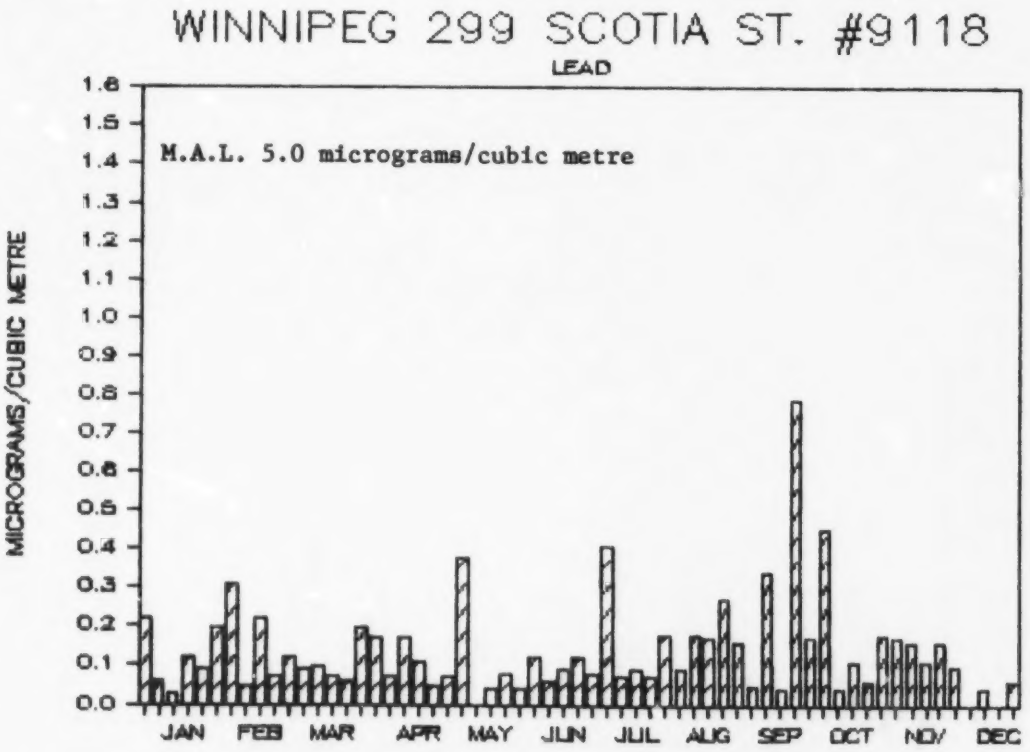
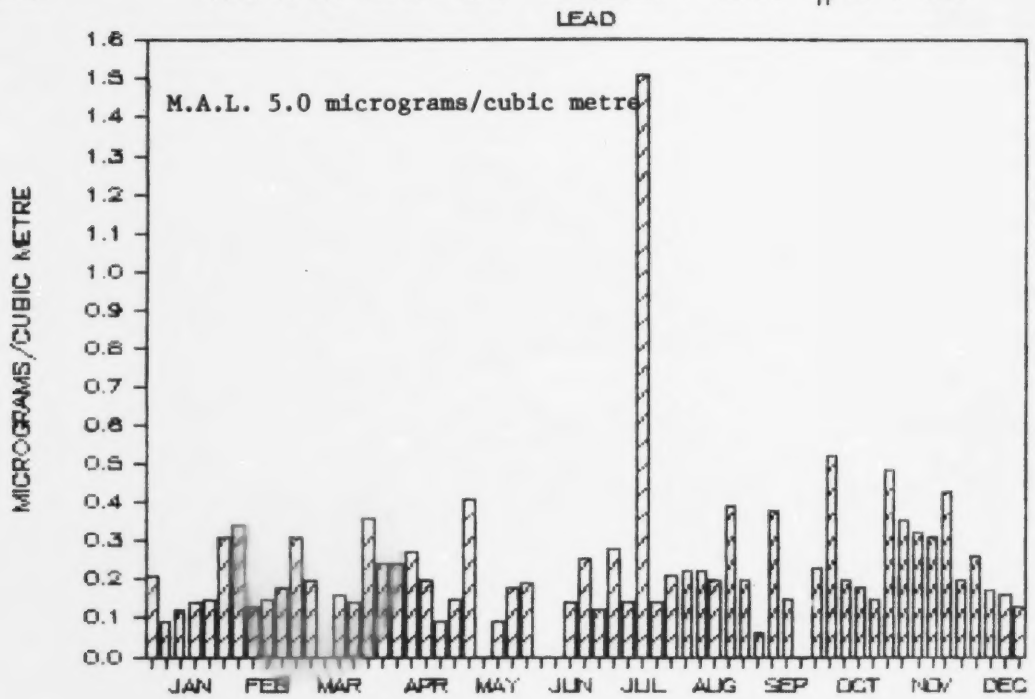

WINNIPEG 299 SCOTIA ST. #9118
LEAD
M.A.L. 5.0 micrograms/cubic metre
MICROGRAMS/CUBIC METRE
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

FIG. 26

WINNIPEG 65 ELLEN ST. #9119



WINNIPEG 604 ST. MARYS RD. #9120

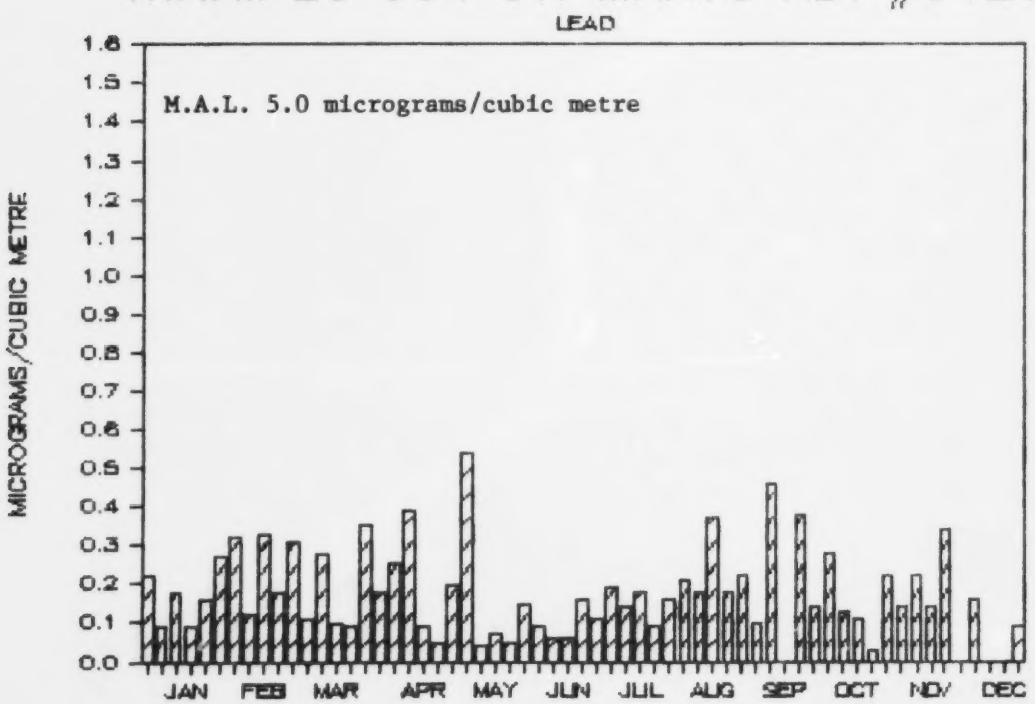
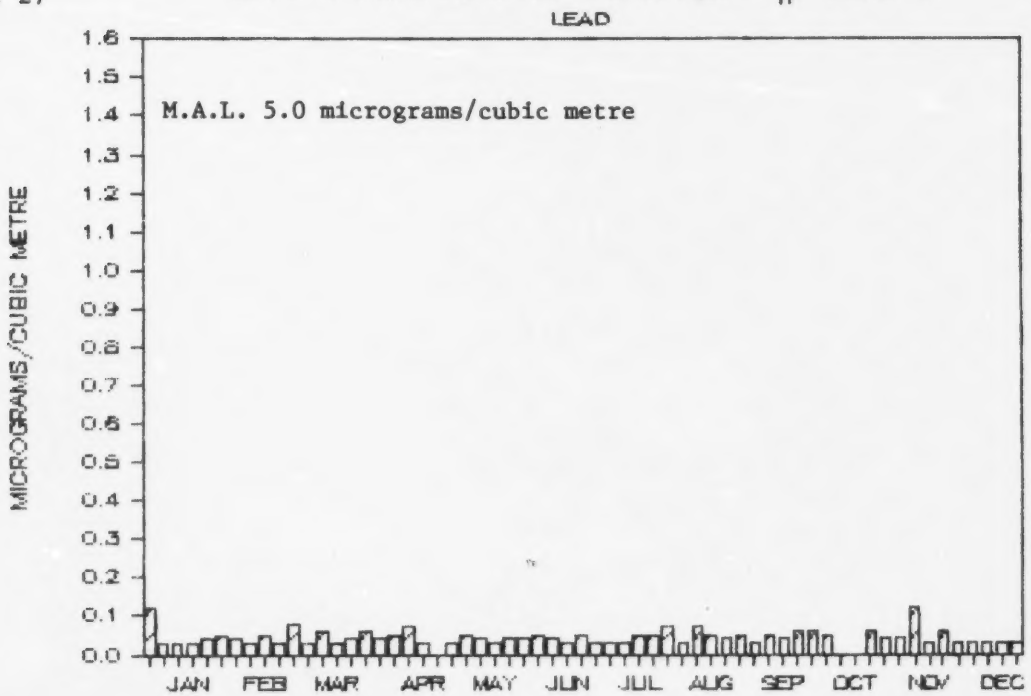


FIG. 27

ST. FRANCOIS XAVIER #4304



BRANDON ASSIN. COMM. COLLEGE #5131

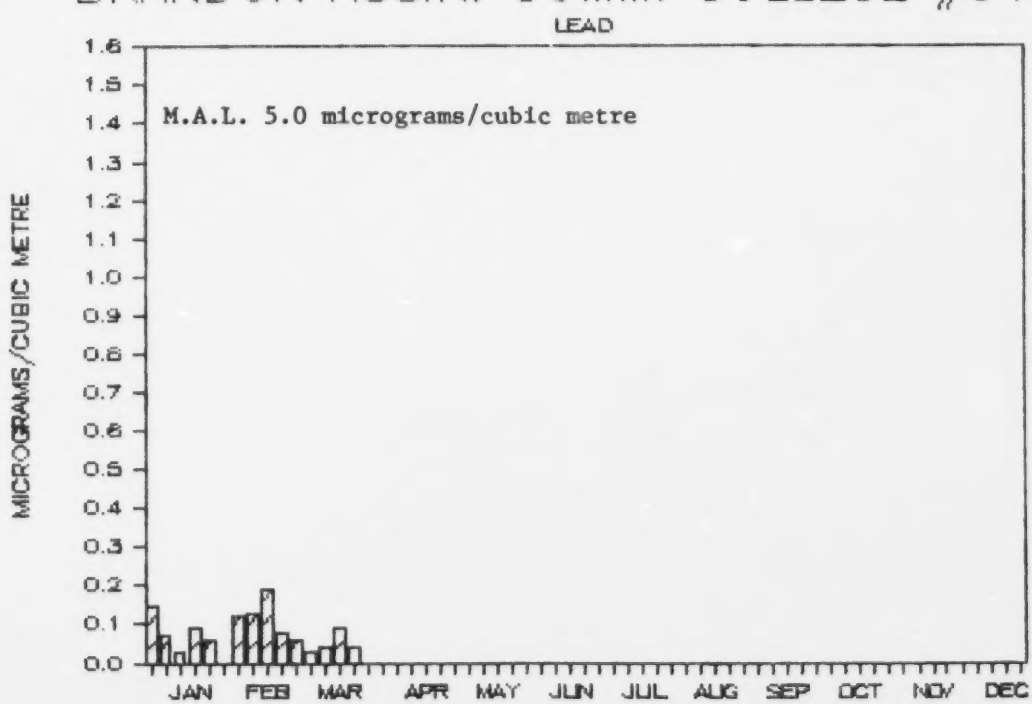


FIG. 28

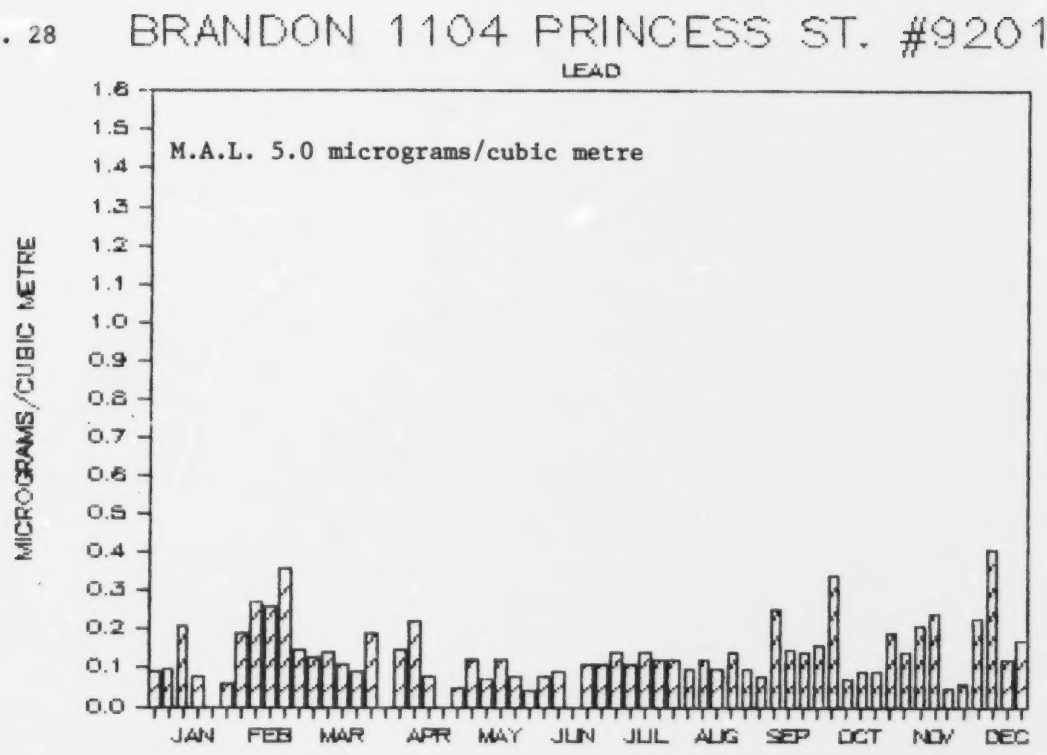
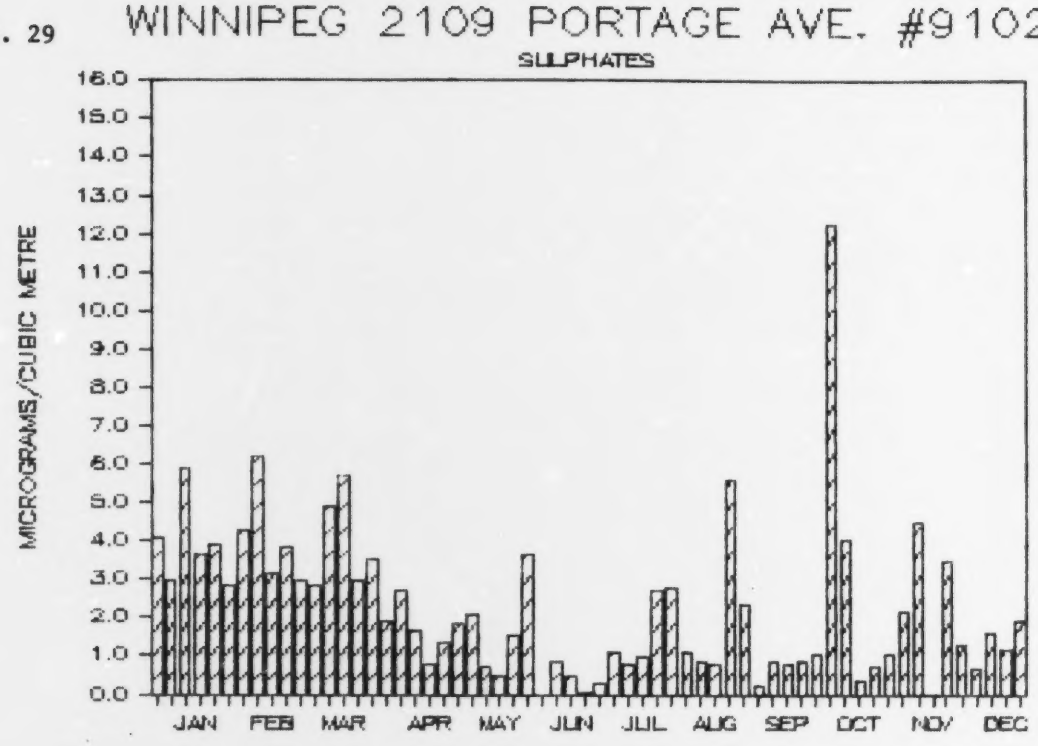

BRANDON 1104 PRINCESS ST. #9201
LEAD
M.A.L. 5.0 micrograms/cubic metre
MICROGRAMS/CUBIC METRE
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIG. 29


WINNIPEG 2109 PORTAGE AVE. #9102
SULPHATES
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

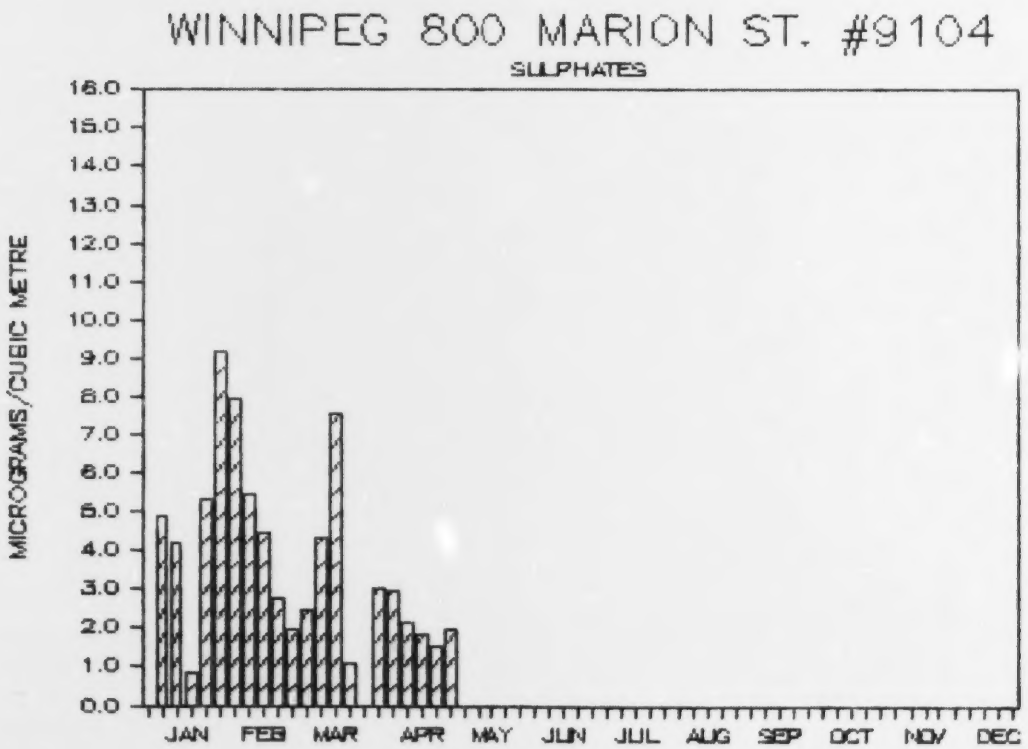
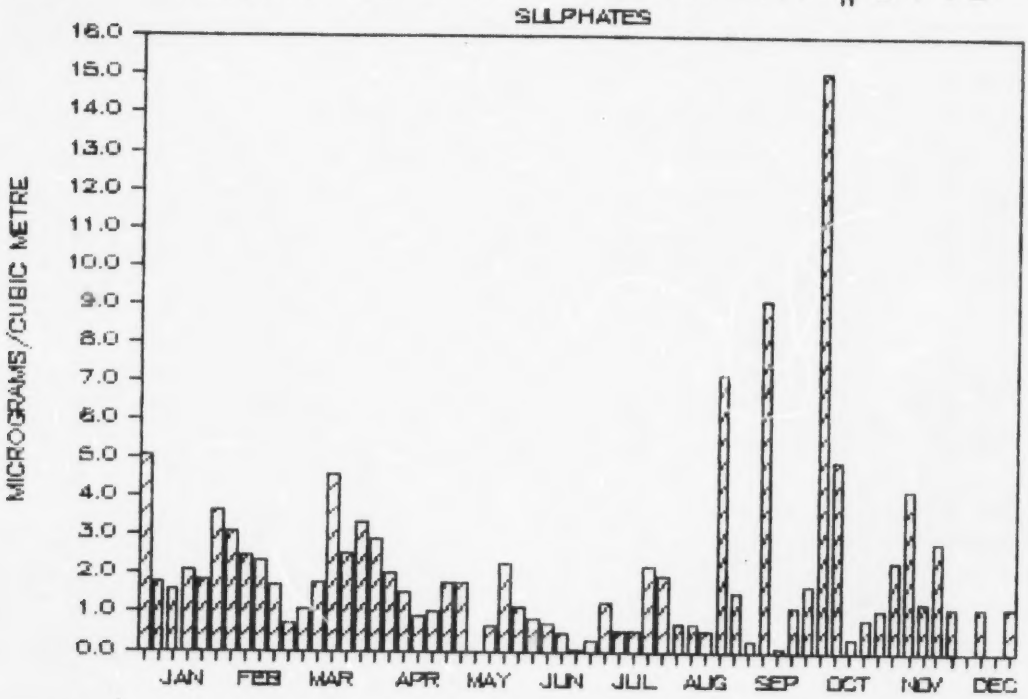

WINNIPEG 800 MARION ST. #9104
SULPHATES
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

FIG. 30

WINNIPEG 299 SCOTIA ST. #9118



WINNIPEG 65 ELLEN ST. #9119

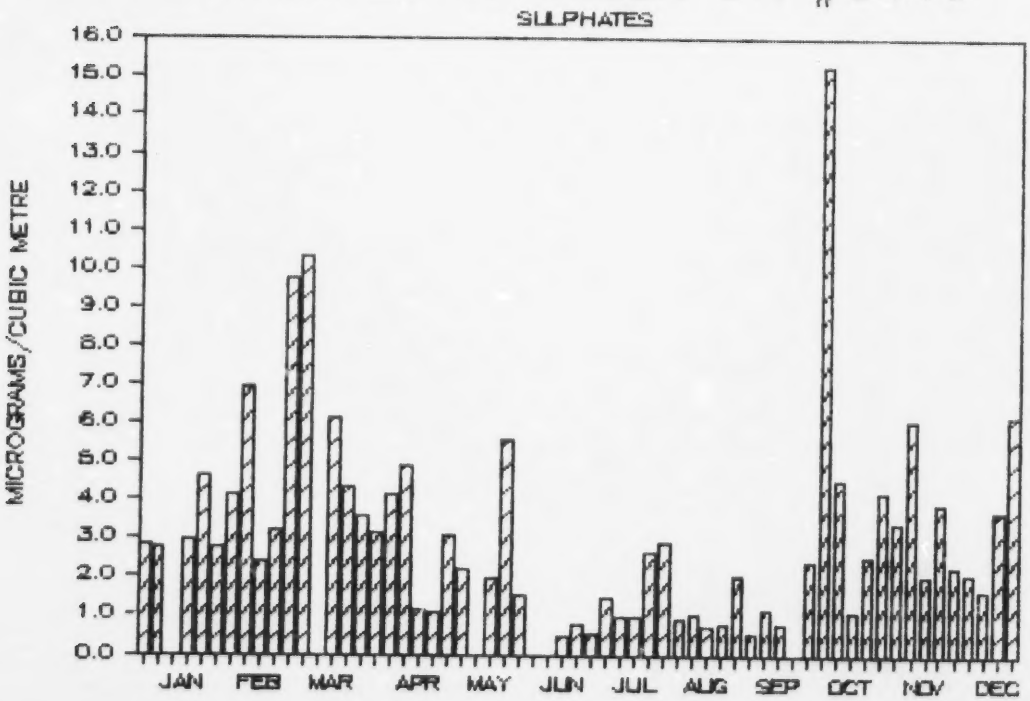
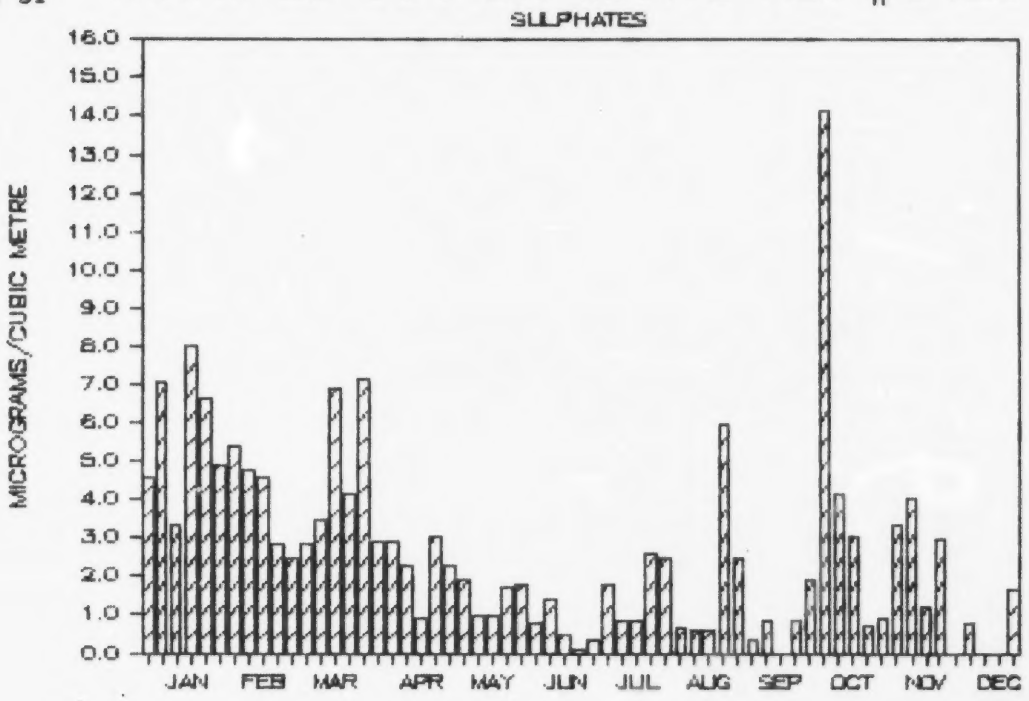


FIG. 31

WINNIPEG 604 ST. MARYS RD. #9120



BRANDON ASSIN. COMM. COLLEGE #5131

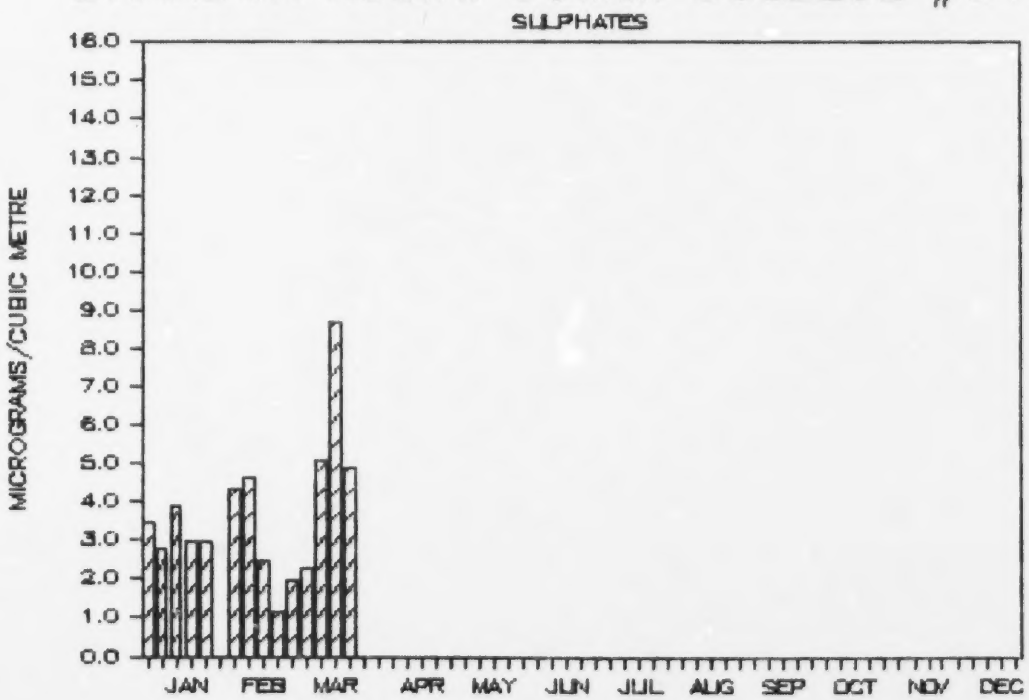


FIG. 32

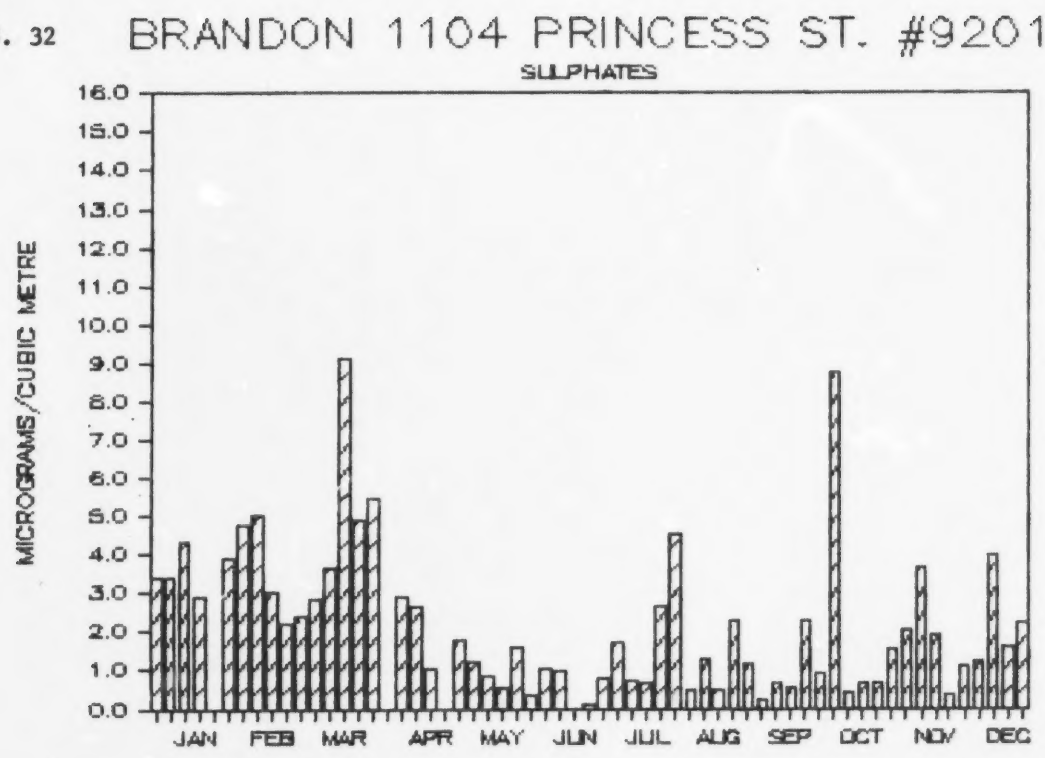
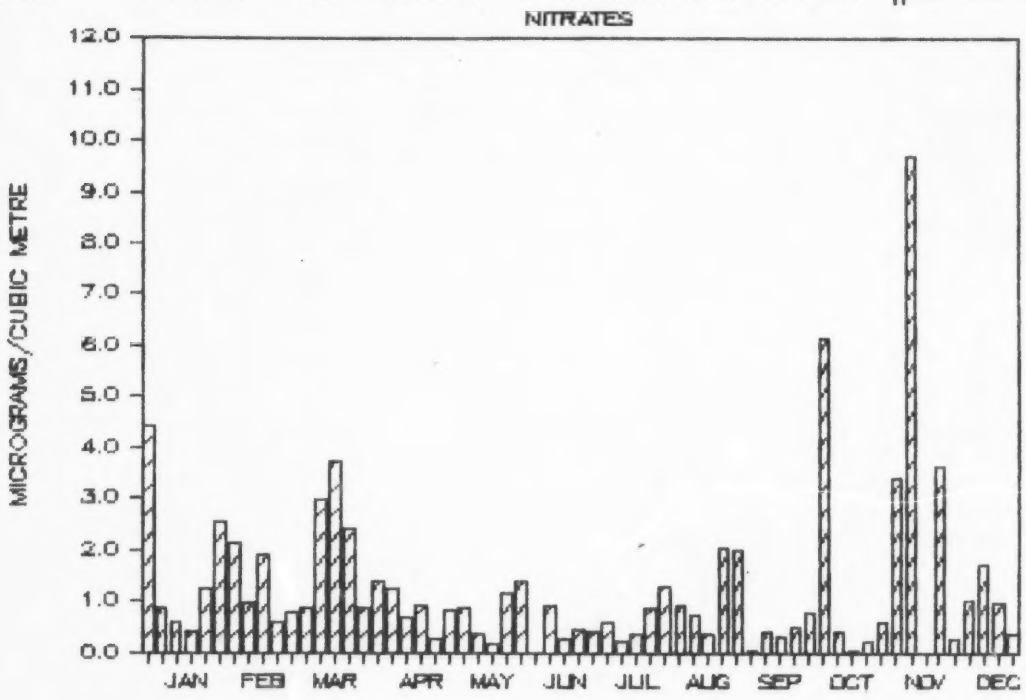

BRANDON 1104 PRINCESS ST. #9201
SULPHATES
MICROGRAMS/CUBIC METRE
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIG. 33

WINNIPEG 2109 PORTAGE AVE. #9102



WINNIPEG 800 MARION ST. #9104

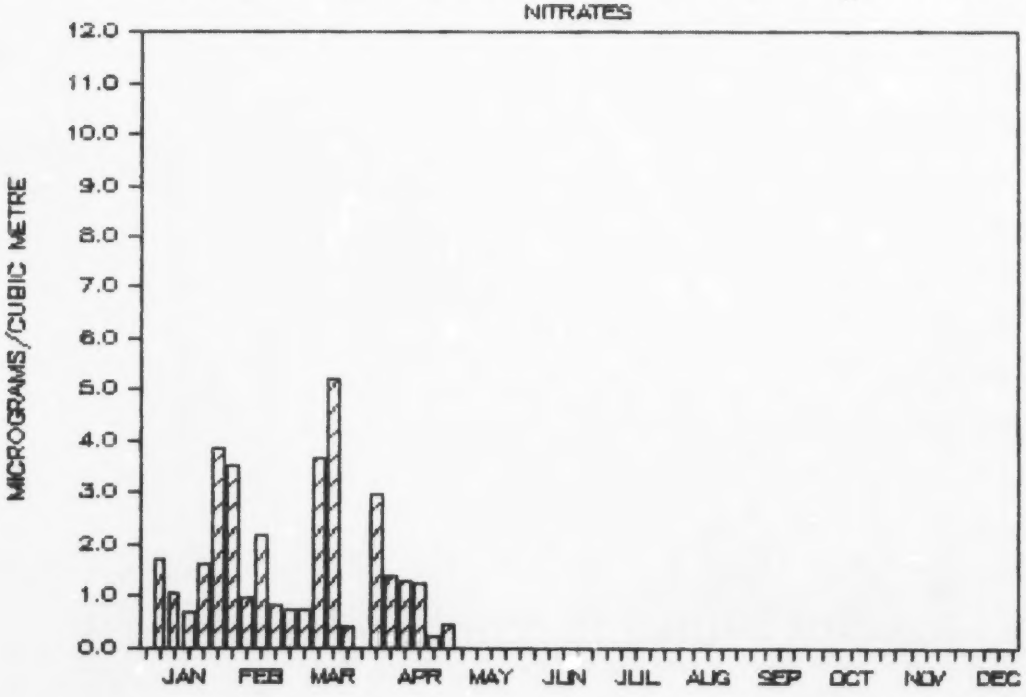
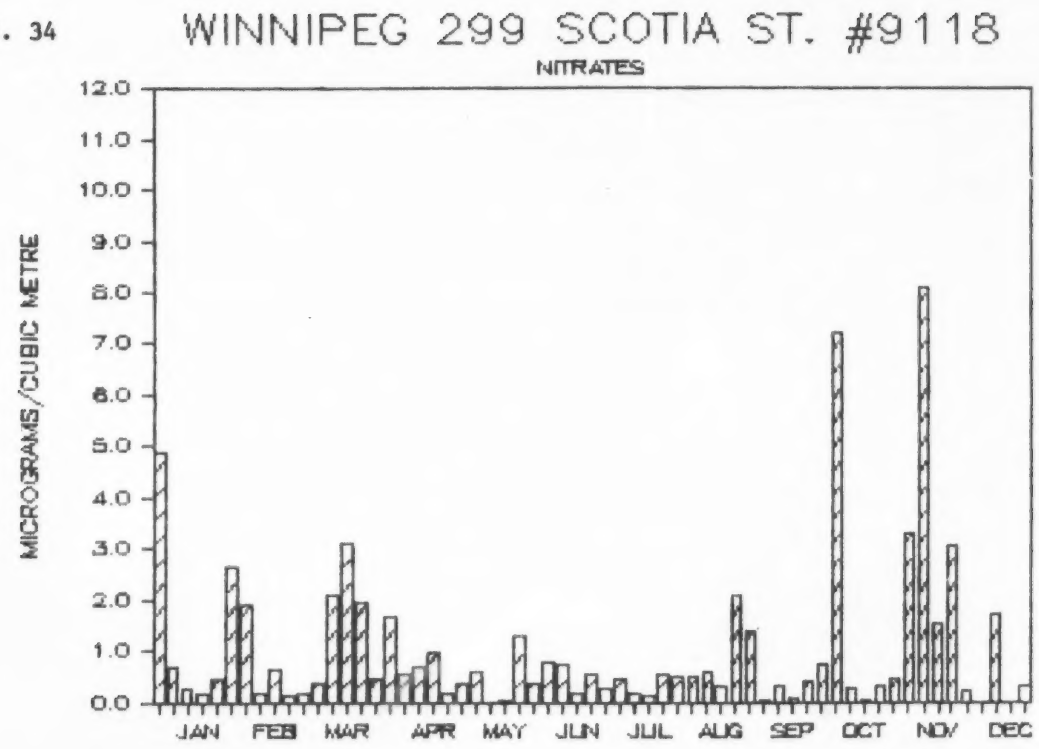


FIG. 34


WINNIPEG 299 SCOTIA ST. #9118
NITRATES
MICROGRAMS/CUBIC METRE
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

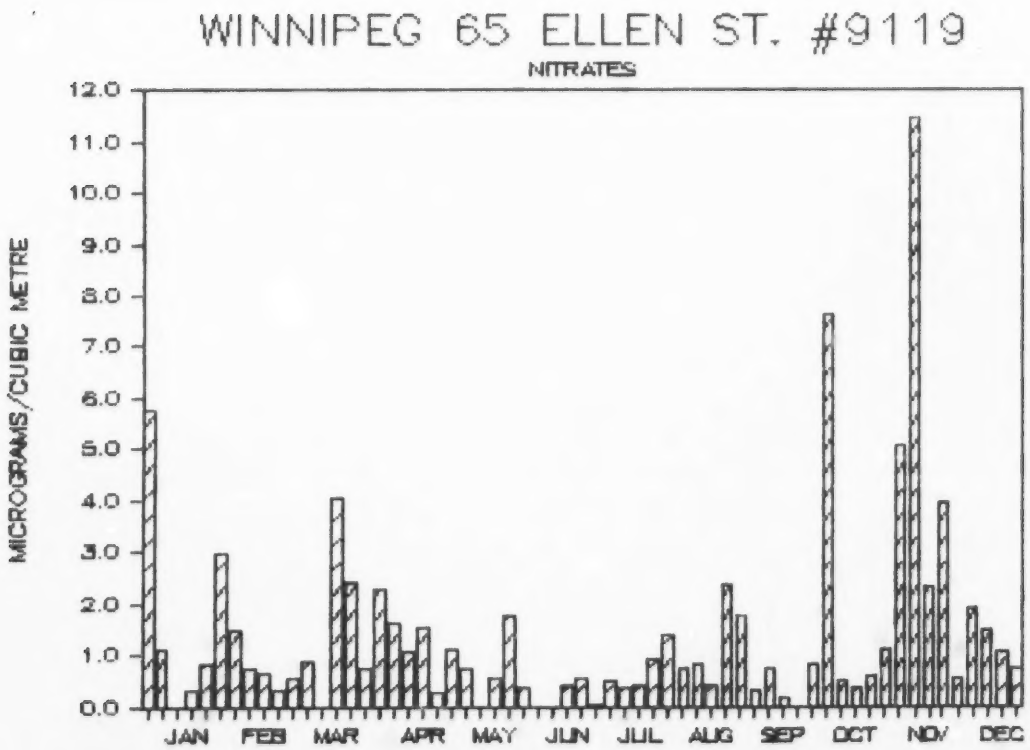
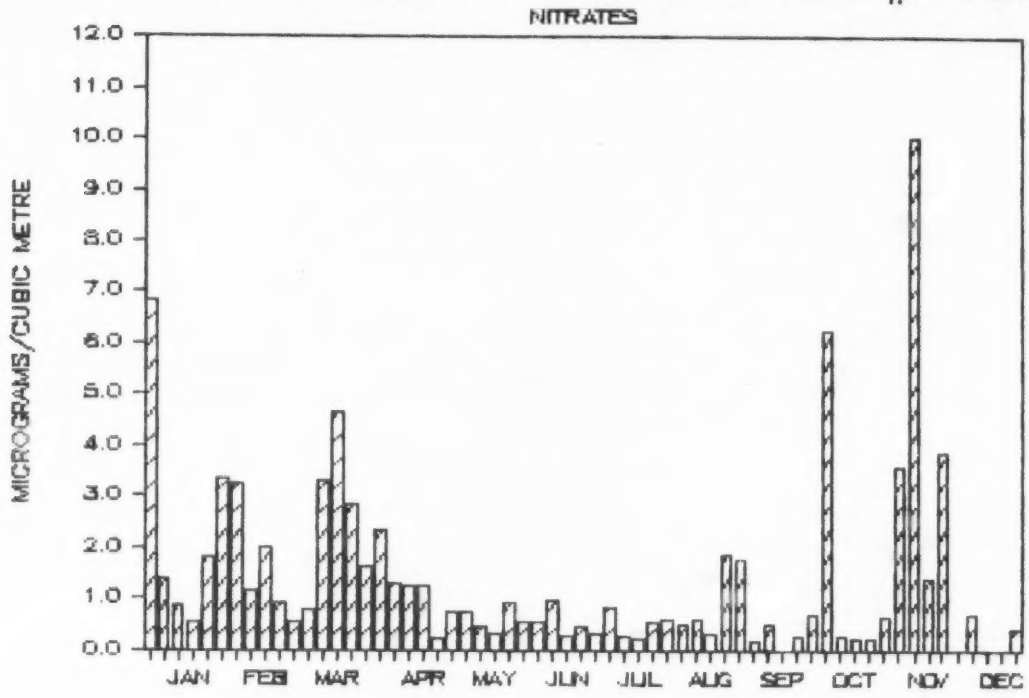

WINNIPEG 65 ELLEN ST. #9119
NITRATES
MICROGRAMS/CUBIC METRE
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIG. 35

WINNIPEG 604 ST. MARYS RD. #9120



BRANDON ASSIN. COMM. COLLEGE #5131

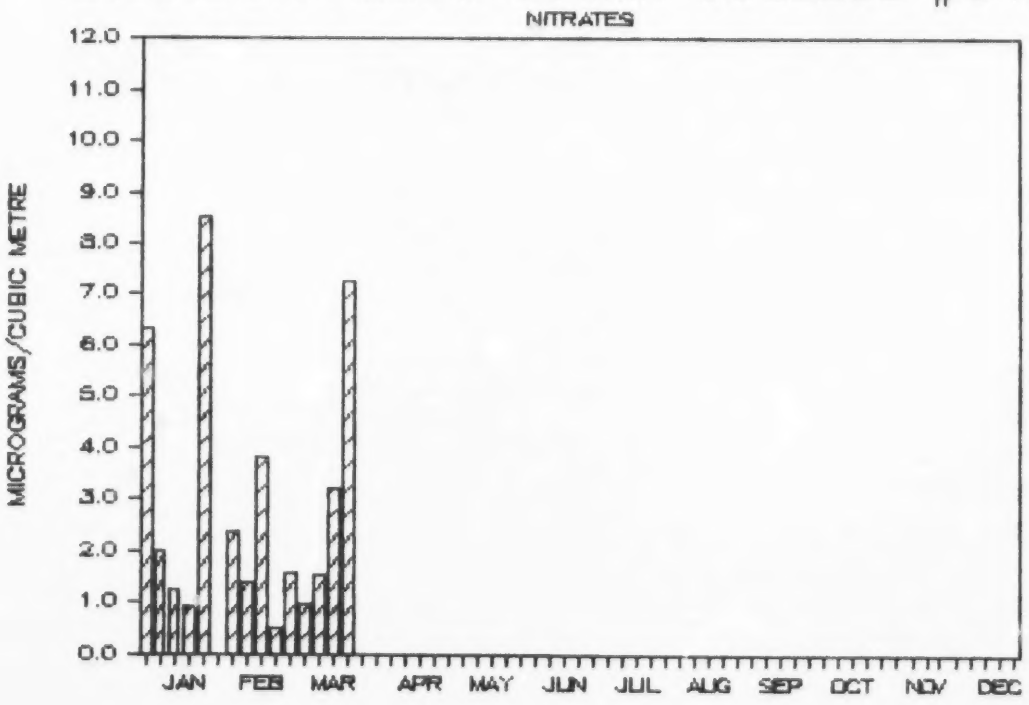


FIG. 36

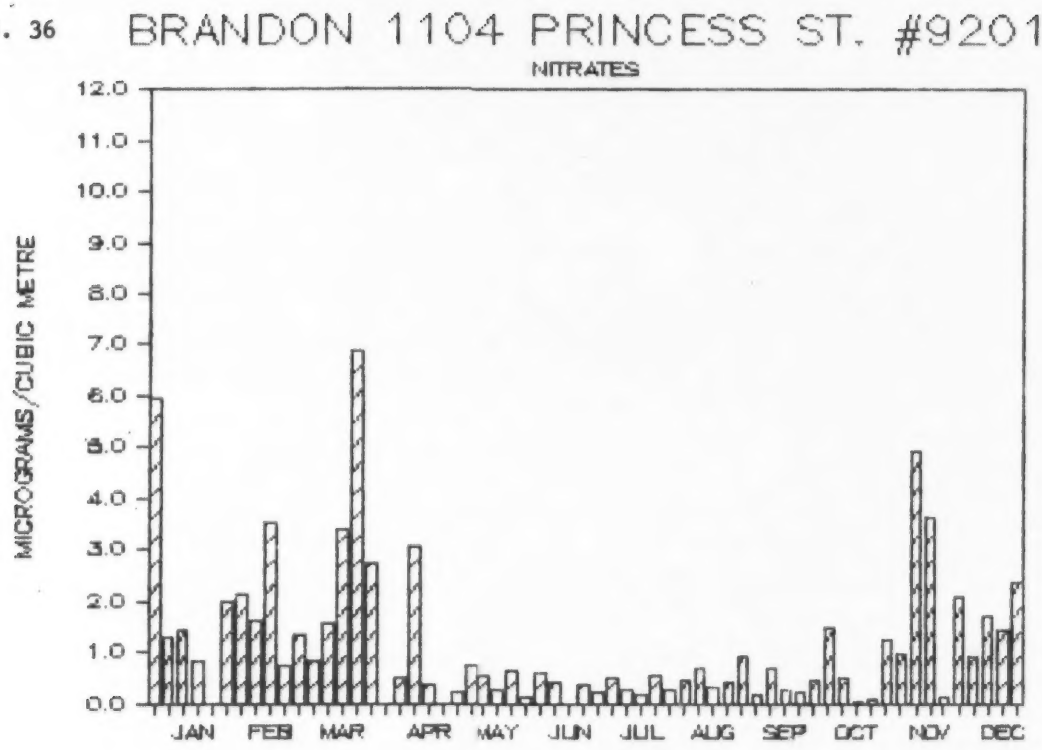
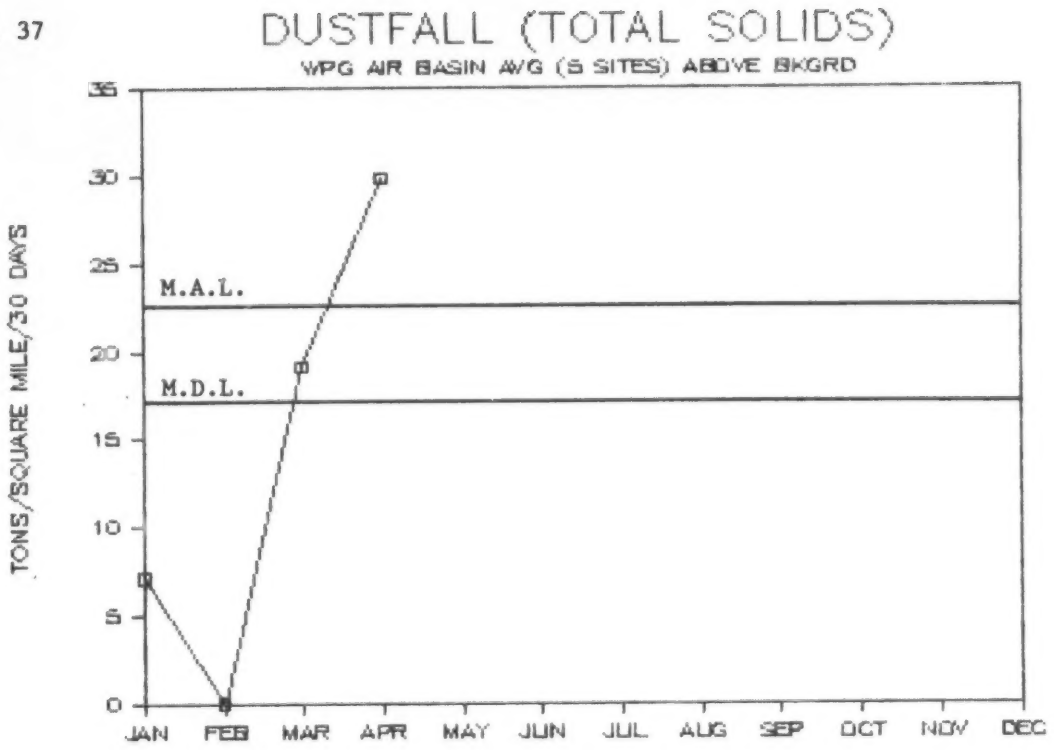

BRANDON 1104 PRINCESS ST. #9201
NITRATES
MICROGRAMS/CUBIC METRE
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIG. 37


DUSTFALL (TOTAL SOLIDS)
WPG AIR BASIN AVG (5 SITES) ABOVE BKGRD
TONS/SQUARE MILE/30 DAYS
35
30
25
20
15
10
5
0
M.A.L.
M.D.L.
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC